13 May 1861.

The Gift of
Samuel Abbot Green, M.D.
of
Boston
(Class of 1851).
8 Jan., 1861.

Imperfect –

EXPLANATIONS AND SAILING DIRECTIONS

TO ACCOMPANY THE

WIND AND CURRENT CHARTS,

APPROVED BY

COMMODORE CHARLES MORRIS,

CHIEF OF THE BUREAU OF ORDNANCE AND HYDROGRAPHY;

AND PUBLISHED BY AUTHORITY OF

HON. J. P. KENNEDY,

SECRETARY OF THE NAVY.

Matthew Fontaine

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of Boston.

THE WIND AND CURRENT CHARTS.

The great demand for these charts among seamen, and the interest which they have excited among philosophers, make it proper that I should give a more detailed account than I have yet given as to the origin and progress of the work, the objects it has in view, and the prospects of success.

This seems to be the more proper because, I hope, by giving such an account, to impress seafaring men and others, who have it in their power to facilitate the work, with the importance of the undertaking.

And to show the importance of the undertaking, it may be as well to quote what one of the most profound of philosophers has said with regard to the subject-matter in hand:

"In the present condition of the surface of our planet," says Baron Humboldt, the most celebrated traveler of the age, "the area of the solid is to that of the fluid parts as 1 to $2\frac{4}{5}$, (according to Rigaud, as 100 to 270.) The islands form scarcely $\frac{1}{23}$ of the continental masses, which are so unequally divided that they consist of three times more land in the northern than in the southern hemisphere; the latter being, therefore, pre-eminently oceanic. From 40° South Latitude, to the Antarctic Pole, the Earth is almost entirely covered with water. The fluid element predominates in like manner between the eastern shores of the old, and the western shores of the new continent, being only interspersed with some few insular groups. The learned hydrographer, Fleurieu, has very justly named this vast oceanic basin which, under the tropics, extends over 145° of longitude, the Great Ocean, in contradistinction to all other seas. The southern and western hemispheres (reckoning the latter from the meridian of Teneriffe) are, therefore, more rich in water than any other region of the whole earth.

"These are the main points involved in the consideration of the relative quantity of land and sea, a relation which exercises so important an influence on the distribution of temperature, the variation in atmospheric pressure, the direction of the winds, and the quantity of moisture contained in the air, with which the development of vegetation is so essentially connected. When we consider that nearly three-fourths of the upper surface of our planet are covered with water, we shall be less surprised at the imperfect condition of meteorology before the beginning of the present century; since it is only during the subsequent period that numerous accurate observations on the temperature of the sea at different latitudes, and at different seasons, have been made and numerically compared together."—*Humboldt's Cosmos.*

"I beg you to express to Lieut. Maury, the author of the beautiful Charts of the Winds and Currents, prepared with so much care and profound learning, my hearty gratitude and esteem. It is a great undertaking, equally important to the practical navigator and for the advance of meteorology in general. It has been

viewed in this light in Germany by all persons who have a taste for physical geography. In an analogous way anything of isothermal countries (countries of equal annual temperature,) has for the first time become really fruitful, since Dove has taught us the isotherms of the several months chiefly on the land; since two-thirds of the atmosphere rest upon the sea, Maury's work is so much the more welcome and valuable because it includes at the same time the oceanic currents, the course of the winds and the temperature. How remarkable are the relations of temperatures, in Sheet No. 2, South Atlantic, East and West of Longitude 40; how much would this department of meteorology gain if it were filled up according to Maury's proposition in Commodore Lewis Warrington's Log Book. The shortening of the voyage from the United States to the Equator, is a beautiful result of this undertaking. The bountiful manner in which these Charts are distributed raises our expectations still higher."—*Baron Von Humboldt to Dr. Flügel, U. S. Consul, Leipsic.*

It is not for the benefit of navigation alone that seamen are invited to make observations and collect materials for the Wind and Current Charts; other great interests besides those of commerce have their origin in the ocean or the air; and, without doubt, these interests are to be benefited by a better knowledge than we now have of the laws which govern the circulation of the atmosphere, and regulate the movements of the aqueous portions of our planet.

The agricultural capacities of any place are as dependent upon the hygrometrical as upon the thermometrical condition of the atmosphere. This is obvious, and of easy illustration:

Each kind of plant requires for its most perfect development a certain degree of moisture, and the winds which bring it that moisture can only get it from the sea or other evaporating surfaces.

It is often argued because wine and olives, or other staples, are produced upon a given parallel of latitude, that therefore they should be produced upon the same parallel wherever the proper soil is to be found.

Whereas, the consideration as to the route which the winds from the ocean have to pursue in order to reach the situation of the supposed parallel, has much to do with the case.

Virginia and California are between the same parallels, yet how different their agricultural resources, the character and the flavor of their fruits, all owing not so much to difference of soil as to the way the winds blow, the quantity of moisture they bring with them, the proportion of clouds and sunshine allotted to each place.

The system of researches embraced by the Wind and Current Charts, therefore it would appear, concern the philosopher and the husbandman, as well as the mariner, the merchant and the statesman.

A wider field, or one more rich with promise, has never engaged the attention of the philosopher. Though much trodden and often frequented, it has never been explored, if we take exploration to mean the collecting and grouping all those phenomena which mariners observe in relation to the ocean and the air above it, with the view of tracing, in the true spirit of inductive philosophy, fact into effect, and effect up to cause.

The mariner, therefore, should bear it always in mind when he is making and recording out upon the wide ocean an observation in connection with these Charts, that upon the fidelity with which that observation and the record of it are made, depends the ability here to read aright the workings of those physical agents that are employed in the grand scheme of creation, to produce those results which are the subject of observation with him.

The wind and rain; the vapor and the cloud; the tide, the current, the saltness and depth, and temperature and color of the sea; the shade of the sky; the temperature of the air; the tint and shape of the clouds; the height of the tree on the shore, the size of the leaves, the brilliancy of the flowers;—each and all may be regarded as the exponent of certain physical combinations, and, therefore, as the expression in which nature chooses to announce her own meaning; or if we please, as the language in which she writes down the operation of her own laws. To understand that language, and to interpret aright those laws, is the object of the undertaking which those who co-operate with me have in hand. No fact gathered in such a field as this, therefore, can come amiss to those who tread the walks of inductive philosophy, for in the hand-book of nature, every such fact is a syllable, and it is by patiently collecting fact after fact, and by joining together syllable after syllable, that we may finally seek to read aright from the great volume which the mariner at sea and the philosopher on the mountain see spread out before them.

Dr. Buist, a learned and eminent *savant* of India, has drawn a beautiful picture of the field in which navigators are so earnestly invited to labor and lend their help.

In the report on the affairs of the "Bombay Geographical Society," presented by the Secretary at the annual meeting, in May, 1850, the Doctor remarks: "The Assistant Secretary of your society,* Mr. Macfarlane, has made considerable progress in the construction of Wind and Current Charts, founded on the information supplied by ships' logs, and on the principle of Lieutenant Maury. It is more than probable that besides the currents occasioned by the trade-winds, monsoons, and set of the tides, we have a group of movements intermingled with those dependent mainly on evaporation. When it is remembered that on the western shore of the Arabian sea, including in this the Red sea and Persian gulf, from the line northward, we have an expanse of coast of not less than 6,000 miles, and a stretch of country of probably not less than 100 miles inland from this, where the average fall of rain does not amount to four inches annually, where not one-half of this ever reaches the sea, and where, to the best of our knowledge, the evaporation over the ocean averages at least a quarter of an inch daily, all the year round, or close on eight feet annually, some idea of the enormous abstraction of water in the shape of vapor may be formed. On the assumption that this extends no further, on an average, than 50 miles out to sea, we shall have no less than 39 cubic miles of water raised annually in vapor from the northern and northwestern side of the basin, which must be supplied from the open ocean on the South or the rain on the East. The fall of rains on the western side of the ridge of the mountain chain, from Cape Comorin to Cutch, averages pretty nearly 180 inches annually, and of this at least 160 is carried off to the sea: that on the Concan to 70 inches, of which probably 30 flow off to the ocean: or betwixt the two, over an area of twenty miles from the sea-shore to the ghauts, and about 1200 miles from the North to the South, or an area of 24,000 square miles in all, we shall probably have an average discharge of nine feet, or close on forty cubic miles of water,—an amount sufficient, were it not diffused, to raise the sea on our shores three feet high, over an area of 72,000 square miles.

*Vide Transactions Bombay Geographical Society, Vol. IX—1850, p. LXXX, et seq.

"The waters of the ocean cover nearly three-fourths of the surface of the globe; and of the thirty-eight millions of miles of dry land in existence, twenty-eight millions belong to the northern hemisphere. The mean depth of the ocean is somewhere about four miles—the greatest depth the sounding line has ever reached is five and a quarter miles.* The mean elevation of the land, again, is about one thousand feet—the highest point known to us, is nearly as much above the level of the sea, as the great depth that has been measured, is below it. The atmosphere, again, surrounds the earth like a vast envelope: its depth, by reason of the tenuity attained by it, as the superincumbent pressure is withdrawn, is unknown to us,—but is guessed at somewhere betwixt fifty and five hundred miles. Its weight, and its constituent elements, have been determined with the utmost accuracy. The weight of the mass is equal to that of a solid globe of lead sixty miles in diameter. Its principal elements are oxygen and nitrogen gases, with a vast quantity of water suspended in them in the shape of vapor, and commingled with these a quantity of carbon in the shape of fixed air, equal to restore from its mass, many fold the coal that now exists in the world. In common with all substances, the ocean and the air are increased in bulk, and consequently diminished in weight, by heat; like all fluids, they are mobile, tending to extend themselves equally in all directions, and to fill up depressions in whatever vacant space will admit them; hence, in these respects, the resemblance betwixt their movements. Water is not compressible or elastic, and it may be solidified into ice or vaporized into steam: the air is elastic—it may be condensed to any extent by pressure, or expanded to an indefinite degree of tenuity by pressure being removed from it—it is not liable to undergo any change in its constitution beyond these, by any of the ordinary influences by which it is affected. These facts are few and simple enough—let us see what results arise from them. As the constant exposure of the Equatorial regions of the Earth to the Sun must necessarily here engender a vast amount of heat,—and as his absence from the polar regions must in like manner promote an infinite accumulation of cold,—to fit the entire Earth for a habitation to similar races of beings, a constant interchange and communion, betwixt the heat of the one and the cold of the other, must be carried on. The ease and simplicity with which this is effected, surpasses all description. The air heated near the equator by the overpowering influences of the Sun, is expanded and lightened: it ascends into upper space, leaving a partial vacuum at the surface to be supplied from the regions adjoining. Two currents from the poles towards the equator, are thus established at the surface, while the sublimated air, diffusing itself by its mobility, flows in the upper regions of space from the equator towards the poles. Two vast whirlpools are thus established, constantly carrying away the heat from the torrid towards the icy regions, and these becoming cold by contact with the ice, carry back their gelid freight to refresh the torrid zone. Did the Earth, as was long believed, stand still while the Sun circled around it, we should have had two sets of meridianal currents blowing at the surface of the Earth, directly from North and South, towards the equator, in the upper regions flowing back again to the place whence they came. On the other hand, were the heating and cooling influences, just

*Lieutenant Walsh, U. S. N., while co-operating in the U. S. Schooner "Taney," with me in these researches, reports a sounding in the North Atlantic of 6½ miles, (5700 fathoms,) without bottom. M.

referred to, to cease, and the Earth to fail in impressing its own motion on the atmosphere, we should have a furious hurricane rushing round the globe, at the rate of 1,000 miles an hour,—tornadoes of ten times the speed of the most violent now known to us, sweeping everything before them. A combination of the two influences, modified by the friction of the Earth, which tends to draw the air after it, gives us the trade winds, which sweep round the equatorial region of the globe unceasingly, at the speed of from ten to twenty miles an hour, the ærial current, quitting the polar regions with the comparatively tardy speed, from East to West, imposed on it by the velocity due to the 70th parallel, is left behind the globe, and deflected into an oblique current, as it advances southward, till, meeting the current from the opposite pole near the equator, the two combine and form the vast stream known as the trades,—separated in two, where the air ascends by the belt of variable winds and rains. Impressed with the motion of the air, constantly sweeping its surface in one direction, and obeying the same laws of motion, the great sea itself would be excited into currents similar to those of the air, were it not walled in by continents, and subjected to other control. As it is, there are constant currents flowing from the torrid towards the frigid zone, to supply the vast mass of vapor there drained off; while other whirlpools and currents, such as the gigantic Gulf Stream, come to perform their part in the same stupendous drama. The current just named, sweeps from the Cape of Good Hope, across the South Atlantic, to the Gulf of Mexico, and by the Straits of the Bahamas. Here it turns to the eastward again, travelling along the coast of Ameriea at the rate of from forty to a hundred miles a day; it now stands once more across the Atlantic, and divides itself into two branches;—one finds its way into the northern sea, warming the adjoining waters as it advances, and turning back, most likely to form a second great whirlpool, re-joining the original stream near Newfoundland. The main branch seeks the northern shores of Europe, and, sweeping along the coast of Spain and Portugal, travels southward by the Azores to rejoin the main whirlpool. The waters of this vast Ocean river, are to the North of the tropic greatly warmer than those around; the climate of every country it approaches is improved by it, and the Laplander is enabled by its means to live, and cultivate his barley, in a latitude which everywhere else, throughout the world is condemned to perpetual sterility. But there are other laws which the great sea obeys, which peculiarly adapt it as the vehicle of interchange of heat and cold betwixt those regions where either exists in excess. Water which contracts regularly from the boiling point downwards, at a temperature of 40°, has reached its maximum of density, and thence begins to grow lighter and expand. But for this most beneficent provision, the vast recesses of the northern ocean would be continually occupied with a fluid at the freezing point, which the least access of cold would convert into one solid mass of ice. The non-conducting power of water, which at present acts so valuable a part in the general economy, so far from being a blessing would be a curse. No warmth could ever penetrate to thaw the foundations of the frozen masses—no water find its way to float it from its foundations, so that, like the everlasting hills themselves, rooted immovable in its place, every year adding to its mass; the solid structure would continually advance to the southward, hermetically sealing the polar ocean thus condemned to utter desolation, and encroaching on the North sea itself. Under existing circumstances, so soon as water is cooled down to 40°, it sinks to the bottom, and, still eight degrees warmer than ice, it attacks the basis and saps the foundations of

the icebergs—themselves gigantic glaciers, which have fallen from the mountains into the sea, or which have grown to their present size in the shelter of bays and estuaries, and by accumulations from above. Once forced from their anchorage, the first storm that arises drifts them to sea, where the beautiful law which renders ice lighter than the warmest water enables it to float,—and drifts southward a vast magazine of cold to cool the tepid water which bears it along,—the evaporation at the equator causing a deficit, the melting and accumulation of the ice in the frigid zone giving rise to an excess of accumulation, which tends along with the action of the air, and other causes, to institute and maintain the transporting current. These stupendous masses, which have been seen at sea in the form of church spires and gothic towers, and minarets, rising to the height of from 300 to 600 feet, and extending over an area of not less than six square miles, the masses above water being only one-tenth of the whole, are often to be found within the tropics. A striking fact dependant on this general law, has just been brought to light; there is a line extending from pole to pole, at or under the surface of the ocean, where an invariable temperature of 39.5 is maintained. The depth of this varies with the latitude; at the equator it is 7,200 feet—at latitude 56° it ascends to the surface, the temperature of the sea being here uniform throughout. North and South of this the cold water is uppermost, and at latitude 70° the line of uniform temperature descends to 4,500. But these, though amongst the most regular and magnificent, are but a small number of the contrivances by which the vast and beneficent ends of nature are brought about. Ascent from the surface of the Earth, produces the same change in point of climate, as an approach to the poles; even under the torrid zone, mountains reach the line of perpetual congelation at nearly a third less altitude than the extreme elevation which they sometimes attain: at the poles snow is perpetual at the ground, and at the different intervening latitudes, reaches some intermediate point of congelation, betwixt one and 20,000 feet. In America, from the line south to the tropics, as also, as there is now every reason to believe, in Africa, within similar latitudes, vast ridges of mountains covered with perpetual snow, run northward and southward in the line of the meridian right across the path of the trade winds. A similar ridge, though of less magnificent dimensions, traverses the peninsula of Hindoostan, increasing in altitude as it approaches the line,—attaining an elevation of 8,500 feet at Dodabetta, and above 6,000 in Ceylon. The Alps in Europe, and the gigantic chain of the Himalayas in Asia, both far South in the temperate zone, stretch from East to West, and intercept the ærial current from the North. Others of lesser note, in the equatorial or meridianal, or some intermediate direction, cross the paths of the atmospherical currents in every direction, imparting to them fresh supplies of cold, as they themselves obtain from them warmth in exchange; in strictness, the two operations are the same. Magnificent and stupendous as are the effects and results of the water and of air acting independently, on each other, in equalising the temperature of the globe, they are still more so when combined. One cubic inch of water when invested with a sufficiency of heat, will form one cubic foot of steam—the water before its evaporation, and the vapor which it forms, being exactly of the same temperature, though in reality, in the process of conversion, 1,700 degrees of heat have been absorbed or carried away from the vicinage, and rendered latent or imperceptible; this heat is returned in a sensible and perceptible form the moment the vapor is converted once more into water. The general fact is the same

in the case of vapor carried off by dry air, at any temperature that may be imagined, for down far below the freezing point, evaporation proceeds uninterruptedly, or raised into steam by artificial means. The air, heated and dried as it sweeps over the arid surface of the soil, drinks up by day myriads of tons of moisture from the sea—as much indeed as would, were no moisture restored to it, depress its whole surface at the rate of four feet annually over the surface of the globe. The quantity of heat thus converted from a sensible or perceptible, to an insensible or latent state, is almost incredible. The action equally goes on, and with the like results, over the surface of the Earth, as over that of the sea, where there is moisture to be withdrawn. But night, and the seasons of the year, come around, and the surplus temperature thus withdrawn and stored away, at the time it might have proved superfluous or inconvenient, is reserved, and rendered back so soon as it is required; and the cold of night, and the rigor of winter, are modified by the heat given out at the point of condensation, by dew, rain, hail, and snow.

" There are, however, cases in which were the process of evaporation to go on without interruption and without limit, that order and regularity might be disturbed which it is the great object of the Creator apparently for an indefinite time to maintain, and in the arrangements for equalizing temperature the equilibrium of saltness be disturbed in certain portions of the sea, and that of moisture under ground in the warmer regions of the earth. To prevent this, checks and counterpoises interpose just as their services come to be required. It could scarcely be imagined that in such of our inland seas as were connected by a narrow strait with the Ocean, and were thus cut off from free access to its waters, the supply of fresh water which pours into them from the rivers around would exactly supply the amount carried away by evaporation. Salt never rises in steam, and it is the pure element alone that is drawn off. We have in such cases as the Black and Baltic seas an excess of supply over what is required, the surplus in the latter case flowing off through the Dardanelles, in the former through the Great and Little Belts. The vapor withdrawn from the Mediterranean exceeds by about a third the whole amount of fresh water poured into it; the difference is made up by a current through the straits of Gibraltar in the latter: and a similar arrangement, modified by circumstances, must exist in all cases where circumstances are similar,—the supply of water rushing through the strait from the open ocean being in exact proportion to the difference betwixt that provided from rain or by rivers, and that required by the afflux of vapor; seas wholly isolated, such as the Caspian and the Dead sea, attain in course of time a state of perfect equilibrium—their surface becoming lowered in level and diminished in area, till it becomes exactly of the proper size to yield in vapor the whole waters poured in. The Dead Sea, before attaining this condition of repose, has sunk thirteen hundred feet below the Mediterranean, the Caspian about one-fourth of this. Lakes originally salt, and which to all appearance, are no more than fragments severed from the sea by the earthquake or volcano, and which have no river or rain supplies whatever, in process of time dry up and become a mass of rock salt in their former basin. Such is the formation in progress in the lake near Tadjurra, nearly five hundred feet below the level of the sea, its waters having been thus much depressed by evaporation, having now almost altogether vanished, one mass of salt remaining in their room. As it is clear in a case such as that of the Mediterranean, that where salt water to a large extent was poured in and fresh water only

was drawn off, a constant concentration of brine must occur, the proposition was laid down by the most distinguished of our Geologists, and long held unquestionable, that huge accumulations of salt in masses larger than all that Cheshire contains, were being formed in its depths. The doctrine eminently improbable in itself, is now met by the discovery of an outward under-current, in all likelihood of brine. It is matter of easy demonstration, that without some such arrangement as this, the Red sea must long ere now have been converted into one mass of salt, its upper waters at all events being known in reality to differ at present but little in saltness from those of the Southern ocean. The Red sea forms an excellent illustration of all kindred cases. Here we have salt water flowing in perpetually through the straits of Babelmandeb, to furnish the supplies for a mass of vapor calculated, were the strait shut up, to lower the whole surface of the sea eight feet annually,—and even with the open strait, to add to its contents a proportionate quantity of salt. But an under current of brine, which from its gravity, seeks the bottom, flows out again to mingle with the waters of the Great Arabian sea, where swept along by currents, and raised to the surface by tides and shoals, it is mingled by the waves through the other waters, which yearly receive the enormous monsoon torrents, the Concan and the Ghaut's supply, become diluted to the proper strength of sea water and rendered uniform in their constitution, by the agitation of the storms which then prevail. Flowing back again from the coasts of India, where they are now in excess, to those of Africa, where they suffer from perpetual drainage, the same round of operations go on continually; and the sea, with all its estuaries and its inlets, retains the same limit, and nearly the same constitution, for unnumbered ages. A like check prevents on shore the extreme heating and desiccation from which the ground would otherwise suffer. The earth is a bad conductor of heat: the rays of the Sun which enter its surface, and raise the temperature to 100 or 150°, scarcely penetrate a foot into the ground; a few feet down, the warmth of the ground is nearly the same night and day. The moisture which is there preserved free from the influence of currents of air, is never raised into vapor: so soon as the upper stratum of earth becomes thoroughly dried, capillary action by means of which all excess of water was withdrawn, ceases, and even under the heats of the tropics, the soil two feet down will be found on the approach of the rains sufficiently moist for the nourishment of plants. The splendid flowers and vigorous foliage which burst forth in May, when the parched soil would lead us to look for nothing but sterility, need in no way surprise us: fountains of water, boundless in extent and limited in depth by the thickness of the soil which contains them, have been set aside and sealed up for their use, beyond the reach of those thirsty winds or burning rays which are suffered only to carry off the water which is superfluous, and would be pernicious, removing it to other lands, where its agency is required, or treasuring it up in the crystal vault of the firmament, as the material of clouds and dew—and the source, when the fitting season comes round again, of those deluges of rain which provide for the wants of the year.

" Such are some of the examples which may be supplied of general laws operating over nearly the whole surface of the terraqueous globe. Amongst the local provisions ancillary to these, are the monsoons of India and the land and sea-breezes prevalent throughout the tropical coasts. When a promontory such as that of India intrudes into the region of the trade winds, the continuous western current is interrupted, and in its

room appear alternating currents from the northeast and southwest, which change their direction as the Sun passes the latitude of the place. On the Malabar coast, as the Sun approaches from the southward, clouds and variable winds attend him, and his transit northward is in a week or ten days followed by that furious burst of thunder and tempest which heralds the rainy season. His southward transit is less distinctly marked; it is the sign of approaching fair weather, and is also attended by thunder and storm. The alternating land and sea-breezes are occasioned by the alternate heating and cooling of the soil, the temperature of the sea remaining nearly uniform. At present, when most powerfully felt, the earth by noon will often be found to have attained a temperature of 120°, while the sea rarely rises above 80°.* The air, heated and expanded, of course ascends, and draws from the sea a fresh supply to fill its room: the current thus generated constitutes the breeze. During the night the earth often sinks to a temperature of 50° or 60°, cooling the conterminous air, and condensing in the form of dew, the moisture floating around. The sea is now from 15° to 20° warmer than the earth—the greatest difference between the two existing at sunrise; and in then rushes the air, and draws off a current from the shore.

"We have not noticed the tides, which obedient to the Sun and Moon, daily convey two vast masses of water round the globe, and which twice a month, rising to an unusual height, visit elevations which otherwise are dry. During one half of the year the highest tides visit us by day, the other half by night, and at Bombay, at Springs, the depths of the two differ by two or three feet from each other. The tides simply rise and fall in the open ocean, to an elevation of two or three feet in all: along our shores, and up gulfs and estuaries, they sweep with the violence of a torrent, having a general range of ten or twelve feet—sometimes, as at Fundy in America, at Brest and Milford Haven in Europe, to a height of from forty to sixty feet. They sweep our shores from filth and purify our rivers and inlets, affording to the residents of our Islands and Continents the benefits of a bi-diurnal ablution, and giving a health and freshness and purity wherever they appear. Obedient to the influence of bodies many millions of miles removed from them, their subjection is not the less complete: the vast volume of water capable of crushing by its weight the most stupendous barriers that can be opposed to it, and bearing on its bosom the navies of the world, impetuously rushing against our shores, gently stops at a given line, and flows back again to its place when the word goes forth—'thus far shalt thou go, and no farther;' and that which no human power or contrivance could have repelled, returns at its appointed time so regularly and surely, that the hour of its approach, and measure of its mass, may be predicted with unerring certainty centuries beforehand. The hurricanes which whirl with such fearful violence over the surface, raising the waters of the sea to enormous elevations, and submerging coasts and islands, attended as they are by the fearful attributes of thunder and deluges of rain—seem requisite to deflagrate the noxious gases which have accumulated—to commingle in one healthful mass the polluted elements of the air, and restore it fitted for the ends designed for it. It is with the ordinary, not with the exceptionable, operations we have at present to deal, and the laws which rule the hurricane form themselves the subject of a treatise.

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* The temperature of certain parts of the Indian Ocean—the hottest sea in the world—is 90°.—M.

"We have hitherto dealt with the sea and air,—the one the medium through which the commerce of all nations is transported, the other the means by which it is moved along,—as themselves the great vehicles of moisture, heat, and cold, throughout the regions of the world—the means of securing the interchange of these inestimable commodities, so that excess may be removed to where deficiency exists, deficiency substituted for excess, to the unbounded advantage of all. We have selected this group of illustrations for our views, because they are the most obvious, the most simple and the most intelligible and beautiful, that could be chosen. Short as our space is, and largely as it has already been trenched upon, we must not confine ourselves to these.

"We have already said that the atmosphere forms a spherical shell, surrounding the earth to a depth which is unknown to us, by reason of its growing tenuity, as it is released from the pressure of its own superincumbent mass. Its upper surface cannot be nearer to us than fifty, and can scarcely be more remote than five hundred miles. It surrounds us on all sides, yet we see it not; it presses on us with a load of fifteen pounds on every square inch of surface of our bodies, or from seventy to one hundred tons on us in all, yet we do not so much as feel its weight. Softer than the finest down—more impalpable than the finest gossamer,—it leaves the cobweb undisturbed, and scarcely stirs the lightest flower that feeds on the dew it supplies; yet it bears the fleets of nations on its wings around the world, and crushes the most refractory substances with its weight. When in motion, its force is sufficient to level the most stately forests, and stable buildings, with the Earth—to raise the waters of the ocean into ridges like mountains, and dash the strongest ships to pieces like toys. It warms and cools by turns the Earth and the living creatures that inhabit it. It draws up vapors from the sea and land, retains them dissolved in itself, or suspended in cisterns of clouds, and throws them down again as rain or dew, when they are required. It bends the rays of the sun from their path, to give us the twilight of evening and of dawn—it disperses and refracts their various tints to beautify the approach and the retreat of the orb of day. But for the atmosphere, sunshine would burst on us and fail us at once—and at once remove us from midnight darkness to the blaze of noon. We should have no twilight to soften and beautify the landscape—no clouds to shade us from the scorching heat, but the bald earth as it revolved on its axis, would turn its tanned and weakened front to the full and unmitigated rays of the lord of day. It affords the gas which vivifies and warms our frames, and receives into itself that which has been polluted by use, and is thrown off as noxious. It feeds the flame of life exactly as it does that of the fire,—it is in both cases consumed, and affords the food of consumption—in both cases it becomes combined with charcoal, which requires it for combustion, and is removed by it when this is over. 'It is only the girdling encircling air,' says a writer in the North British Review, 'that flows above and around all that makes the whole world kin. The carbonic acid with which to-day our breathing fills the air, to-morrow seeks its way round the world. The date trees that grow round the falls of the Nile will drink it in by their leaves; the cedars of Lebanon will take of it to add to their stature; the cocoanuts of Tahiti will grow rapidly upon it; and the palms and bananas of Japan, will change it into flowers. The oxygen we are breathing was distilled for us some short time ago by the magnolias of the Susquehanna, and the great trees that skirt the Orinoco and the Amazon—the giant rhododendrons of the Himalayas contributed to it, and the roses and myrtles of Cashmere, the Cinnamon tree of Ceylon, and

the forest older than the flood, buried deep in the heart of Africa far behind the mountains of the Moon. The rain we see descending was thawed for us out of the icebergs which have watched the Polar Star for ages, and the lotus lillies have soaked up from the Nile and exhaled as vapor, snows that rested on the summits of the Alps.' 'The atmosphere,' says Maun, 'which forms the outer surface of the habitable world, is a vast reservoir, into which the supply of food designed for living creatures is thrown—or, in one word, it is itself the food in its simple form of all living creatures. The animal grinds down the fibre and the tissue of the plant, or the nutritious store that has been laid up within its cells, and converts these into the substance of which its own organs are composed. The plant acquires the organs and nutritious store thus yielded up as food to the animal, from the invulnerable air surrounding it.' But animals are furnished with the means of locomotion and of seizure—they can approach their food, and lay hold of and swallow it; plants must await till their food comes to them. No solid particles find access to their frames; the restless ambient air, which rushes past them loaded with the carbon, the hydrogen, the oxygen, the water—everything they need in the shape of supplies, is constantly at hand to minister to their wants, not only to afford them food in due season, but in the shape and fashion in which alone it can avail them."

Surely a more tempting field for philosophical research, for useful and honorable labor, or a field more abounding with the elements of useful and practical results, never engaged the attention of man.

By studying the winds at sea we might expect to find them blowing more conformably there than on the land to the general laws which govern the circulation of the atmosphere. And in endeavoring to learn these laws, we may look for the rule at sea: for the exceptions, on the land. It might therefore be expected that any undertaking to group the observations of mariners upon the winds in all parts of the ocean, and at all seasons of the year would be regarded, as the illustrious Humboldt says this is, and as the learned Dr. Buist shows it is, with no little interest by philosophers and philanthropists, by good and wise men in all conditions of life, and in all parts of the world.

In the progress of this undertaking, many new facts of interest to science have been brought to light, or their existence suggested. Our knowledge of the laws which govern the circulation of the atmosphere, which control the currents of the sea, which regulate climates, and by which heat and moisture, clouds and sunshine, are distributed over the surface of the Earth, has been considerably enlarged even by the results so far obtained.

Navigation has already reaped a rich reward from this undertaking, and commerce is profiting by it. In consequence of the increase of knowledge which it has given to the practical navigator, with regard to the prevailing winds and currents of the sea, the average sailing passage between distant parts of the earth has been materially shortened.

Practically, for commercial purposes, these investigations have lifted up, as it were, the markets of the southern hemisphere, and placed them nearer to our doors by several—and in some cases, by many—days' sail than they were before; for the time which it required a ship to carry a cargo from one hemisphere to another, has been shortened more than two weeks at some seasons of the year; and it is not going too far to say that

the voyage hence to California has in consequence of these researches been shortened to a more remarkable extent. The average passage out by vessels not having the results of these researches to guide them is upwards of 180 days; but vessels with these charts on board have made it in 107, in 97, in 96, in 91 and even in 90 days; and their masters, after making allowance for the improved models of their ships, ascribe this great success to the information which they derived from these charts as to the winds and currents by the way.

The merchants and shipmasters of India, perceiving the great benefits which American commerce and American merchants, shipmasters and owners, were deriving from this system of investigations as developed in part only for the Atlantic ocean, have promptly stepped forward, raised a subscription for the purpose, and directed a set of Wind and Current Charts upon the plan of these, to be undertaken for the Indian ocean; and the Geographical Society of Bombay, composed of men eminent for their virtue and learning, has given the undertaking its countenance.

After having spent much time and labor upon this undertaking, and after having made considerable progress with it, it came to the knowledge of the Society that I was very much in want of materials for "Wind and Current Charts" for the Indian ocean. Therefore the Geographical Society of Bombay, with a spirit of liberality and a degree of friendly consideration for which I am profoundly thankful, resolved to place at my disposal all the work which has been accomplished under the auspices of the Society.

This work consists of track Charts of the Indian ocean extending from the Cape of Good Hope to 170° E. They are on the scale of the Wind and Current Charts. These MS. Charts are six in number, they have the shore-line sketched in, and the tracks of one hundred vessels—in all colors—projected upon them.

The notes and explanations necessary to enable me to incorporate these charts with my own, however, have not yet arrived.

The following extract is from the letter of Dr. Buist, a member of the Society, and one of the most devoted friends of science to be found in any quarter of the globe.

"Bombay, *November* 17, 1851.

"Lieut. Maury, *National Observatory*, *Washington*,

My Dear Sir:—You will receive along with this, or shortly afterwards, a tin case, through Smith, Elder & Co., containing the skeleton charts commenced by the Geographical Society, to which I have repeatedly alluded, and with which I am now authorized to present you. We shall endeavor to do our best to provide you with all the information we can collect to enable you to extend your researches to the India seas; only you must remember that while you belong to the fastest, we live in the slowest country in the world, and the time we take to conduct a preliminary official correspondence suffices you for the commencement and completion of your work. I work here not only single-handed but with a world of obstacles actually thrown in my way, with the labor of a daily paper on my shoulders, a school of industry to attend to, and generally a severe attack of sickness three or four times a year, so if I get on slowly it is not because of my doing little, but because of my profession, by which I have exhausted four-fifths of my time and strength. * * *

"Though I have published very little on meteorology for want of time to put the stock of information I have collected in order, I have beside me an enormous mass of facts. Three years since I began to perceive that we had certain classes of storms that occurred periodically, not only all over India, but all over the region to which my information extended, and that these were synchronous or nearly so; I then began a series of maps illustrative of the matter. I have sent you specimens, but for this we were too scantily provided with information. Instrumental observations are too much insisted on, when excellence is not attainable they are better dispensed with: the remarks of an observant man, recorded at the time, with due advertence to day and hour, are invaluable. Surely these might be had in abundance for the future, if not for the past. This you will observe, is intimately connected and in perfect consonance with your theories of the electric or magnetic origin of all meteorological phenomena.

"Through this means alone can the occurrence of storms simultaneously round the one half of the world be accounted for. Have you any good sets of hourly barometric observations from your southern States? If you will turn to the London Philosophical Transactions of 1850, you will see a paper by Colonel Sykes, on the observations made in India, which will show you the interest attaching to barometrical tides, within and beyond the tropics, and we are most anxious to discover the law they obey till they become merged, and to a great measure lost in, vast casual fluctuations." * * *

About the same time I had the pleasure to receive a letter from C. Meldrum, Esq., Secretary of the Meteorological Society of Mauritius, manifesting the same friendly spirit on the part of that Society, and offering to do in aid of our undertaking whatever might be done at that important meteorological station. This kind offer was gladly accepted, and Mr. Meldrum was requested to have copied at the expense of the Observatory the abstract logs of vessels arriving at Mauritius.

In the mean time Kupffer, the laborious meteorologist of Russia, had suggested the idea of a conference between the meteorologists of Russia and those of the United States, with a view to a more general co-operation and concert of action between them; while this subject was under advisement, a proposition was made by the British Government that that of the United States should co-operate with it in its plans for making meteorological observations at certain foreign stations, and according to instructions that had been prepared by direction of Major General Sir John Burgoyne, Inspector General of Fortifications. Here was an opportunity unexpectedly offering itself for establishing concert of action among meteorologists on shore, and co-operation among navigators at sea everywhere, in collecting data and materials for the advancement of science and the benefit of navigation. I could not suffer such an opportunity to pass, and therefore, in reply to the British proposition suggested that the sea should be included as well as the land, that the plan should be uniform and universal; and that in order to make it so and to secure its success, I ventured to propose a general conference, to consist among others of meteorologists from the shore and of navigators from the sea, who should take the subject up and discuss the plans, draw up the forms, fix the standards and prescribe the instruments to be used, the instructions to be followed; in short a conference that shall take cognizance of everything whether it have regard to the instruments and their errors, the subjects to be observed, the methods, forms, &c., of reduction.

This is an interesting subject, the move is an important one; the Academy of Sciences at Paris, the British Meteorological Society in London, the Royal Sardinian Society, the Royal Society of Copenhagen, with other Societies and Governments, have already expressed their readiness to participate in the proceedings of this conference. This proposition is one which if it be met in the right spirit and be carried out with dilligence, promises much good. I therefore quote in this place the correspondence in relation to it, especially with the view of bringing the subject to the notice of navigators, and of soliciting for it in advance their hearty good will and cheerful co-operation.

Correspondence in relation to a universal system of Meteorological Observations, for the sea as well as for the land.

British Legation, *Washington, Nov.* 13, 1851.

Sir:—I have been instructed by Her Majesty's Government to present to the United States Government the printed volume which I have the honor to enclose herewith which has been drawn up by Major General Sir John Burgoyne, Inspector General of Fortifications, for the purpose of enabling the officers of the Royal Engineers at foreign stations to take meteorological observations upon an uniform plan; and I am directed to say, that her Majesty's Government would be glad to obtain such co-operation in regard to the objects to which those instructions relate, as the proper department of the United States Government may be willing to afford.

I avail myself of this opportunity to renew to you, Sir, the assurances of my highest consideration.

(Signed) JOHN F. CRAMPTON.

The Honorable Daniel Webster, &c., &c., &c.

Department of State, *Washington, Nov.* 14, 1851.

Sir:—I have the honor to transmit to you, herewith, the copy of a note just received from Her Britannic Majesty's Chargé d'Affaires in this city, together with the printed volume which accompanied it, relative to the co-operation of the Government of the United States with that of Her Britannic Majesty, in carrying out a plan which it has adopted, for the taking of uniform meteorological observations at foreign stations, and to invite your attention to the subject.

I am, Sir, very respectfully,
Your obedient servant,
DANIEL WEBSTER.

Hon. William A. Graham,
Secretary of the Navy.

Bureau of Ordnance and Hydrography, *Nov.* 19, 1851.

Sir:—With this you will receive a communication from the Chargé d'Affaires of Great Britain to the Secretary of State of the United States, covering a printed pamphlet in relation to meteorological observations, and proposing a co-operation by the officers of our Government in making similar observations.

After perusing them you will please state whether such co-operation could be made at the Naval Observatory without interference with other duties, or making any material changes in any arrangements which may now be in use there, for similar purposes. You will also give your views whether any useful co-operation direct or indirect, could be furnished by our vessels at sea, with the instruments usually furnished to them, or at any of our Navy Yards, either with their present instruments or by the aid of others to be furnished for that purpose; and if so, at what yards such observations would be most desirable, having regard to the observations of this kind which are known to be made at different places in connection with the Smithsonian Institute, and public observatories.

Return all the enclosures after perusal.

Respectfully, your obedient servant,

C. MORRIS,

Chief of Bureau.

Lieut. M. F. MAURY,

Supt'dt. &c., &c., Washington.

NATIONAL OBSERVATORY,

Washington, Nov. 21, 1851.

SIR:—I have the honor to acknowledge the receipt of yours of the 19th inst., enclosing a communication from the Chargé d'Affaires of Great Britain to the Secretary of State of the United States, with certain other papers and documents, relative to a proposition by the British Government, to the effect that the Government of the United States will cause its officers who are engaged in making meteorological observations, to co-operate with the Royal Engineers engaged upon like duties on foreign stations, according to the plan set forth in the "Instructions for taking meteorological observations at the principal foreign stations of the Royal Engineers," drawn up by Major General Sir John Burgoyne, Inspector General of Fortifications.

I am directed by you to state "whether such co-operation could be made at the Naval Observatory without interference with other duties, or making any material changes in any arrangements which may now be in use there for similar purposes;" also, to give my "views whether any useful co-operation, direct or indirect, could be furnished by our vessels at sea, with the instruments usually furnished to them; or at any of our Navy Yards, either with their present instruments, or by the aid of others to be furnished for that purpose; and if so, at what yards such observations would be most desirable, having regard to the observations of this kind which are known to be made at different places, in connection with the Smithsonian Institute and public observatories."

In reply, it gives me pleasure to state that the desired co-operation can be made at this Observatory, and at the naval stations generally, without interference with other duties, and with very slight changes in fixtures and arrangements now in use for like purposes.

This is an important subject. Many of the great interests of state, and the well-being of the human family, are to be advanced by increase of knowledge touching the dynamical laws of the atmosphere, and the distribution through it, over the surface of our planet, of electricity, heat and moisture.

For the fruits of his labor the husbandman is dependent upon atmospherical conditions; and commerce is controlled by the course of the winds. The subject, therefore, is one of high scientific interest, and of great national, industrial, and practical import. The step proposed by the British Government is in the right direction: wherefore, to make myself the more clearly understood, I may be excused for referring to the meteorological system of the United States, and for offering a few suggestions amendatory of the British proposition.

The government of the United States has its own system of meteorological observations; one for the sea, another for the land.

Some of the States, as New York and Massachusetts, have, on their own account, established their system of meteorological observations also.

Also, some of the institutions of the country, as the "Smithsonian," and many of our fellow-citizens, are likewise actively engaged in meteorological researches.

The meteorological observatories that are under the control of the different States, of the institutions and of the private citizens of the United States, amount to several hundred. These extend from the shores of the Atlantic to those of the Pacific, and from the farthest northern boundary to the extreme southern limits of the United States.

Over these widely scattered observatories, and over this large corps of observers, their time for observation, their mode and means of observing, and their methods of recording the results of their labors, the government of the United States has no control whatever; nor can it exercise any, except such as may flow from precept and example.

Nevertheless, these observatories, both national, state and private, for the most part, act in concert. They mostly employ the same instruments, refer to the same standards; many of them observe at the same hours, use the same methods, and record by the same forms, most of which differ more or less from those recommended by Major General Sir John Burgoyne for the nineteen "foreign stations of the Royal Engineers."

I do not mean to draw comparisons, or to imply that, of the American and English systems, one is better than the other; far from it. Each is good; and if either be adopted, and made common to the two countries, the science of meteorology would be vastly benefitted and advanced thereby.

If the government of the United States, therefore, without proposing amendments to the English system, were to direct its officers, who are engaged in meteorological observations, to adopt the plan, modes and methods of that system, it would create confusion among our observatories, and be as likely to retard as to advance the progress of meteorological research in the United States.

For this reason I beg leave to suggest a meteorological conference.

By authority of the government, I have been permitted to invite the co-operation of American shipmasters

in making daily, in all parts of the ocean, as they pursue their voyages to and fro, a series of meteorological observations.

By an act of Congress, authority has been given for all the vessels of the Navy to do the same.

The object of this co-operation is not only to improve, for the benefit of commerce and navigation, our knowledge with regard to the winds and currents of the sea, but to investigate the laws of atmospherical and oceanic circulation, and to advance the science of meteorology generally.

Under this invitation, more than a thousand American merchant vessels are engaged in making and recording their observations according to a prescribed form. At the end of the voyage their journals are regularly returned to this office.

They constitute the materials from which the "Wind and Current" Charts are constructed. These Charts, on account of the meteorological information they afford, have led to the developments of new and shorter routes across the seas, and to several other results of interest and value. I beg leave to send a set of them, the explanations which accompany them, &c., for the inspection of Her Majesty's officers.

About five-sevenths of our planet is covered with water.

It will be perceived, therefore, that in studying the course of the "wind in his circuits," and investigating the laws which govern the general circulation of the atmosphere, we must look to the sea for the rule—to the land for the exceptions. Therefore, no general system of meteorological observations can be considered complete unless it embrace the sea as well as the land.

The value of the researches conducted at this office with regard to the meteorology of the sea, would be greatly enhanced by co-operation from the observatories on the land.

Observers with the requisite instruments for this purpose, are already at the principal stations. It is as convenient for them to observe in, as without, concert; for to observe in concert, and according to a uniform plan, would be attended neither by an increase of time, labor or expense; but on the contrary, be a saving of all.

Hence another reason for suggesting a conference upon the subject of a uniform system of meteorological observations on board British and American ships, as well as at British and American posts, stations and observatories. On board of every properly appointed ship of both nations, all, or nearly all, the observations which would probably be recommended for this universal system are already made. It is the custom to keep a log-book on board of every ship, and to enter in that log-book remarks and observations upon the winds, the weather, and the sea; and all that is requisite to impart a new and a greater value to these observations, is that they should be made all at the same time, recorded in a stated journal—the "abstract log" kept for the purpose—and then be made available by being returned to the office appointed to receive them.

The atmosphere envelopes the earth, and all nations are equally interested in the investigations of those laws by which it is governed. There is Russia, upon whose territories the Sun, except in the long night of the Polar winter, never sets, perhaps she, of all nations, has gone to the greatest expense in establishing meteorological observatories on the land, in collecting and publishing results, &c.

From what has already passed between Kupffer, the Russian meteorologist, (also in charge of the mines,) and myself upon the subject, I am induced to believe that he is already authorized, by the proper authorities in that country, to confer with the proper authorities in this, as to the establishment of a uniform system of meteorological observations on the land, for the two countries.

The achievements of France and Germany, in the paths of science, and the monuments they have erected in its name, do not admit us to doubt but that they too, would readily and most heartily second any move which has for its object the great good of establishing, among civilized nations throughout the world, a uniform and universal system of meteorological observations.

There are other nations of Europe not a whit behind Germany and France in their devotion to science, their love of the useful.

For these reasons I therefore respectfully suggest that as an amendment to the British proposition, a more general system be proposed. That England, France, Russia, and other nations be invited to co-operate with their ships, by causing them to keep an abstract log, according to a form to be agreed upon, and that authority be given to confer with the most distinguished navigators and meteorologists, both at home and abroad, for the purpose of devising, adopting, and establishing a universal system of meteorological observations for the sea as well as for the land.

Respectfully, &c.,

(Signed) M. F. MAURY,

Lieut. U. S. N.

Com. Chas. Morris,

Chief of Bureau of Ord. and Hyd., Present.

Bureau of Ordnance and Hydrography, *Dec.* 5, 1851.

Sir:—I have the honor to acknowledge the receipt of your letter of the 17th ultimo, which covered a note to the Secretary of the Navy, from the Secretary of State, transmitting a communication from Her Britannic Majesty's Chargé d'Affaires in this city, and a printed volume relative to the co-operation of the Government of the United States with that of Her Britannic Majesty, in carrying out a plan which it has adopted for the taking of uniform meteorological observations at foreign stations.

To enable me to state more fully the extent to which the navy is prepared to unite in the proposed co-operation, than my recent connection with this Bureau enabled me to do from personal knowledge, a letter was addressed to the Superintendent of the Observatory—a copy of this letter, and of Lieut. Maury's reply, are herewith enclosed.

With a set of Wind and Current Charts, and explanations of them, which have been furnished by Lieut. Maury, I forward Professor Espy's Third Report on Meteorology, and a communication received from Professor Henry, of the Smithsonian Institution, on the same subject.

Collectively, they show the general character and extent of the meteorological observations which have

been made in the United States; and the practical and useful application which has been made of these observations, that have been collected under the direction of the Navy Department. The transmission of these for the inspection of the officers of her Brittanic Majesty, who are engaged or interested in similar observations, is respectfully suggested and submitted for your decision.

Although I concur in the opinion of Lieut. Maury, that it would be inexpedient to substitute, at this time, the plan for observations proposed by General Burgoyne, for that now followed in establishments and vessels under the direction of the Navy Department; changes and additions could probably be made, which could secure a nearer approach to uniformity in our shore establishments, without producing confusion, and they are respectfully recommend to that extent.

The suggestions for a more general and widely extended co-operation upon some uniform plan, promises so many advantages, that hopes may be reasonably indulged for its eventual adoption.

Notwithstanding strict uniformity cannot be yet secured between the observations made by our officers and the British Sovereign's, an interchange of such observations or of the deductions drawn from them, seems to be very desirable, and a proposal for such exchange is respectfully suggested.

With much respect, I am,

Your obedient servant,

CHAS. MORRIS, *Chief of Bureau.*

To the Hon. Wm. A. Graham,

Secretary of the Navy.

Navy Department, *Dec. 6th*, 1851.

Sir:—The communication from the State Department of the 14th ultimo, transmitting a copy of a note from Her Britannic Majesty's Chargé d'Affaires in the city of Washington, together with the printed volume which accompanied it, relative to the co-operation of the government of the United States with that of Her Britannic Majesty, in carrying out a plan which it has adopted for the taking of uniform meteorological observations at foreign stations, and inviting the attention of this Department to the subject, was duly received and referred to the proper bureau for a report as to the extent to which the Navy of the United States is prepared to unite in the proposed co-operation.

This Department, appreciating the importance of co-operation in the meteorological researches between the officers of the Royal Engineers of Her Britannic Majesty's Army, and the officers of the United States, acting under the authority of the Navy Department, cordially reciprocates the spirit in which the proposition of the British government is made.

Concurring in the opinions and approving the suggestions contained in the accompanying letters from the Chief of the Bureau of Ordnance and Hydrography, and from the Superintendent of the Naval Observatory, as to the importance of a system of meteorological observations which shall harmonize and be a guide and rule among observers generally, both at sea and on land, I beg you will assure Her Britannic Majesty's Chargé

d'Affaires that it would afford not only this Department, but the institutions of our country, great satisfaction to see British and American ships, American and British meteorologists, co-operating with others in establishing a general and comprehensive system of observations, and of carrying it out in such a manner that an observation in one part of the world may be readily referred to and compared with like observations made in other parts of the world; and that for the purpose of giving practical effect to these views, the Superintendent of the Naval Observatory is authorized to confer as to such an uniform plan, with Her Majesty's officers, and others of proper jurisdiction, at home and abroad, and, in concert with them, to agree upon a system of observations both for the sea and the land, and which, by being common, effective, and of easy execution, may be followed by meteorologists and navigators generally.

And in connection with this subject, I have the honor to transmit with this communication, a letter from the Chief of the Bureau of Ordnance and Hydrography, with one from the Superintendent of the Naval Observatory, and one from Professor Henry, of the Smithsonian Institution; also, Lieutenant Maury's Sailing Instructions, with his Wind and Current Charts, and Professor Espy's second and third reports on Meteorology.

With very great respect, I have the honor to be,

Your obedient servant,

(Signed) WM. A. GRAHAM.

DANIEL WEBSTER, *Secretary of State.*

NAVY DEPARTMENT, *Dec. 6th*, 1851.

SIR:—Enclosed with this you will receive a copy of a letter from the Honorable Secretary of State to this Department, and the reply thereto, as well as a copy of one from the Chief of the Bureau of Ordnance and Hydrography, relative to the co-operation of the government of the United States with that of Her Britannic Majesty, in carrying out a plan which it has adopted for the taking of uniform meteorological observations at foreign stations.

In furtherance of the views expressed in the letter from this Department to the Secretary of State, you are hereby authorized to confer with Her Britannic Majesty's officers, and others of proper jurisdiction, at home and abroad, and in concert with them, to agree upon a system of observations, both for the sea and the land, which may be followed by meteorologists and navigators generally.

And you will report to this Department, from time to time, the progress made and the results reached in the adoption of such uniform system of observations.

I am, very respectfully,

Your obedient servant,

WM. A. GRAHAM.

Lieut. M. F. MAURY,

Sup't. U. S. Naval Observatory, Washington, D. C.

Extracts from "Instructions for Taking Meteorological Observations,—Drawn up by order of the Inspector General of Fortifications, by Captain Henry James, R. E., F. R. S., &c."[*]

"A 'notice' of the arrangements which have been made for having Meteorological Observations taken at the principal foreign stations of the Royal Engineers, has been published in the corps papers for this year; this 'notice,' with some alterations and additions, is now printed as a separate paper, as instructions for the observers.

"Since the publication of the 'notice,' Major General Sir J. Burgoyne has, with the sanction of the Master General of the Ordnance, invited the co-operation of the Honorable Board of Directors of the East India Company, and the Board of Admiralty, for having similar observations taken in India at those places where the Admiralty have officers competent for the duty, and where there are no other meteorological observatories; and, in consequence, the Board of Directors have ordered twenty sets of instruments to be sent to India, and the Admiralty have ordered four sets to be sent to Ascension, Rio de Janeiro, Callao and Valparaiso. All the instruments are of a similar construction, and will be compared with the standards at the Royal Observatory at Greenwich; thus, with the observations taken at different Government observatories, both at home and abroad, and by the members of the Meteorological Society of London, who have provided themselves with similar instruments, and have many zealous observers amongst their number—and with the observations taken in the different States of Europe and America, under the patronage of their respective Governments—and by Her Majesty's Consuls abroad, who have been instructed by Lord Palmerston to carefully observe and accurately record atmospheric phenomena, to determine the laws, by which storms and variable winds are generated, (see his Lordship's letter and enclosures in the appendix,†) that a greater combination has been effected for collecting accurate data connected with the science of meteorology, than was ever before attempted. The observers, therefore, are earnestly requested zealously to perform their several parts, by regularly and carefully registering their observations, so as to make each set of observations as complete as possible, and thus to furnish accurate data for determining the laws of atmospheric phenomena, and the peculiarities of the climate of the different parts of the world.

"The following memorandum from the Inspector General of fortifications has been addressed to the commanding officers of Royal Engineers:

"'It having been suggested to the Master-General that it might be highly useful to science if a series of meteorological observations were recorded in different parts of the world, on one uniform system, under instructions and by authority, his Lordship has consented that the object should be carried out at the nineteen stations as enumerated below, by or under the immediate directions of the Commanding Royal Engineers at each.

Names of Stations.

1 Bahama,	6 Corfu,	11 Hong Kong,	16 New South Wales,
2 Barbadoes,	7 Demerara,	12 Jamaica,	17 St. Helena,
3 Bermuda,	8 Gibraltar,	13 Malta,	18 Toronto,
4 Cape,	9 Guernsey,	14 Mauritius,	19 Quebec.
5 Ceylon,	10 Halifax,	15 Newfoundland,	

[*] Circulated by order of Major General Sir John Burgoyne, K. C. B., Inspector General of Fortifications, &c., &c. † P. P. 16—25.

" 'Instruments, instructions and books of reference of an uniform description will be forwarded to each station.

" 'The endeavor, in the arrangements, has been to commence, upon a system that shall be compatible with the acquirements of any officer of Engineers, and that shall enable him without difficulty to take measures for a due record being kept, of every matter required, and, at the same time, not call upon any exertions or unnecessary attendance that shall interfere with the more regular necessary duties of the Department.

" 'The Inspector General of Fortifications attaches very great importance to this measure, and trusts to meet with the zealous co-operation of the several commanding Royal Engineers, to carry it out in the most perfect manner.

" 'He requests an early communication from the Commanding Royal Engineers of the first measures taken by them in the matter, with any remarks they may have to offer, and subsequently he would be glad of information, from time to time, of the mode and regularity of the proceedings, with any circumstances worthy of observation.' "

From the Appendix to the same.

" Foreign Office, *April* 30, 1851.

Sir:—I transmit to you copies of a letter, with its enclosures, which I have received from Colonel Reid, of the Royal Engineers, who for many years has devoted his attention to the theory of storms, and whose object has been to investigate, with a view to practical use in navigation, the laws by which storms and variable winds are governed.

In order that an investigation of this nature may be practically useful, it is essential that facts connected with the atmospherical phenomena in question should be carefully observed and accurately recorded over as large a portion as possible of the surface of the globe by persons of education, and whose scientific attainments or professional avocations qualify them for making such observations.

Colonel Reid has suggested that such observations could be most easily made and recorded by captains of ports, masters of light-houses, harbor masters, and others, whose professional pursuits naturally lead them to be constant observers of atmospherical phenomena.

The enclosures in Colonel Reid's letter will more fully point out the manner in which information on the subject of storms may be collected.

I have accordingly to instruct you to use your best endeavors to procure such information on this important subject; and you will transmit to me half yearly an abstract of the information you may have obtained, with such remarks as may suggest themselves to you. If you can add diagrams to show the tracks of any remarkable storms, it would greatly add to the value of your reports. As it is of importance to circulate as widely as possible information as to storm tracks, you should encourage the publication of such information in newspapers and periodical works.

I am, sir, your most obedient, humble servant,

(Signed) PALMERSTON.

Her Majesty's Consul,

At———

[Inclosure—1.]

Lieutenant Colonel Reid to Viscount Palmerston.

14 KENSINGTON GORE, *April* 15, 1851.

MY LORD:—I have the honor to acknowledge the receipt of your Lordship's letter, dated 20th March, 1851, transmitting to me certain documents on the subject of storms. I have sent copies of the whole of them to Mr. Redfield, of New York, having asked the favor of the American Minister to transmit them for me, I inclose herewith a copy of a letter, which I wrote to Mr. Lawrence on transmitting the second set of documents, with the answer which I have received in return.

I have no doubt that the representations of Mr. Lawrence will have the effect of extending these combined Meteorological Observations, hitherto confined to the North Atlantic ocean, to all other parts of the world where American and British officers meet.

I venture to suggest to your Lordship, that a copy of the letter which Mr. Lawrence has addressed to me be circulated among the British Consuls. I inclose also a copy of a circular letter, which was addressed by Lord Glenelg, in 1838, to the Governors of all the British Colonies, which circular letter describes the manner in which information on the subject of storms may be collected; and which if your Lordship should think fit also to transmit to the consuls, it would serve as a very useful guide to them.

I must apologize to your Lordship for proposing to give so much trouble; but I do so from a conviction that further knowledge of the atmospheric laws can only be obtained by interesting very many individuals in the inquiry over extended portions of the globe.

I have, &c.

(Signed) WM. REID,

Lieut. Colonel Royal Engineers.

[Inclosure—2.]

Lieutenant Colonel Reid to Mr. Abbott Lawrence.

14 KENSINGTON GORE, *April* 10, 1851.

SIR:—After I had sent to your Excellency, on the 3d instant, some documents on the subject of Atlantic storms, I received the enclosed papers from the Foreign Office, sent to me by the direction of Lord Palmerston. As these particularly relate to a storm which Mr. W. C. Redfield has been tracing, I beg you will do me the honor of transmitting them for that gentleman.

I take the liberty of informing your Excellency that the attention of the Governors of all British Colonies has been long ago directed to the furtherance of the study of storms, and that Lord Palmerston has directed the attention of British Consuls to the same subject. More recently, an order has been given by the Ordnance Departments, to send meteorological instruments to the commanding engineers at all the British Colonial stations. The American and British people have an immense advantage in using the same language, which has enabled us to trace the storm tracks from the West Indies to Labrador, and thus to make a great step in advance in meteorological science.

My object in entering into this explanation to your Excellency, is respectfully to suggest for your consideration, whether great benefit might not result if your Government would invite your Consuls and Naval Officers, wherever stationed, to join their efforts to those of British Consuls and Officers, in investigating the laws of the winds. A notice published in India by the Governor General, by desire of the Court of Directors, has led to the most important practical results. It is by the combined efforts of American and British, that the knowledge we now possess of Atlantic storms has become of great practical use in navigation, and the unlimited extension of similar efforts to other seas, would, I trust, be of benefit to mankind generally.

I have, &c.

(Signed) WM. REID.

[Notification.]

CALCUTTA, *Wednesday, September* 11, 1839.

The importance of investigating the course and phenomena of storms, has been brought to the notice of Government by the Honorable Court of Directors, and the Honorable the President in Council, is in consequence desirous of obtaining local registers of these phenomenas, taken simultaneously at as many stations of India as may be found possible. The public officers of the different settlements and stations of India, are accordingly invited and requested, upon the occurrence of any hurricane, gale, or other storm of more violence than usual, to note accurately the time of its commencement, the direction from which the wind first blows, whether in gusts or regular, and whether accompanied with rain, thunder and lightning, or other phenomena. Also, to note, with as much accuracy as possible, the changes of direction in the wind, and the time of occurrence of each; and lastly, the duration of the gale, and in what quarter the wind is when it ceases. The variations of the thermometer and barometer at each period noticed, will also be of importance, if the means are forthcoming of making such observations.

The President of the Council refrains from making it the business of any particular officer to note the above circumstances, but relies on the known desire of all enlightened persons to promote objects of scientific and useful enquiry, that the public officers will arrange in such a manner as to insure that the observations will be taken by some one in the vicinity of each station.

Reports upon matters of the description comprehended in this order may be forwarded to the Secretary to Government in the General Department, free of postage (superscribed "Storm Report.")

A scientific gentleman* in Calcutta has obligingly undertaken to combine all reports that may be so received, into a synopsis for exhibition of the results, in the manner adopted and recommended by Colonel Reid, R. E.

By order of the honorable the President of the Council of India in Council.

(Signed) H. T. PRINSEP,

Secretary to the Government of India.

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* "Mr. Piddington."

[Inclosure—3.]

Mr. Abbott Lawrence to Lieutenant Colonel Reid.

LEGATION OF THE UNITED STATES,
London, April 11, 1851.

SIR:—I have the honor to acknowledge the receipt of your letter of yesterday, inclosing for Mr. Redfield a report from Her Majesty's Consul at St. Michael's, of a storm in the Atlantic. I shall have great pleasure in forwarding these to Mr. Redfield, as before, through the Government at Washington, and I shall, in compliance with your suggestion, invite its continued attention to this subject, as I am fully sensible of the important results that may flow from observations vigorously prosecuted with the extended means the Mercantile and Naval Marines and the Consular force of Great Britain and the United States afford.

I have, &c.,
(Signed) ABBOTT LAWRENCE.

[Inclosure—4.]

Circular to Govenors of British Colonies.

DOWNING STREET,
November 29, 1838.

SIR:—I transmit to you a copy of a work lately published by Lieut. Col. Reid of the Royal Engineers, entitled "The law of Storms." The object of the work is to develope, with a view to practical uses in navigation, the laws by which storms and variable winds are governed. In order to make an inquiry of this nature truly useful, it is essential that the facts connected with such phenomena should be collected and arranged over an extended surface, and that accurate records of them should be kept by persons whose education and scientific or professional avocations enable them to estimate the value of such records.

It has been suggested to me that such records could be most easily obtained, and the enquiries on which Colonel Reid has entered be most advantageously followed up, by inviting the co-operation of captains of ports, masters of light-houses, harbor masters, and others, whose professional pursuits naturally lead to the observation of atmospheric phenomena.

A perusal of the enclosed work will convince you of the interest and importance of this inquiry, and I feel assured that you will be anxious to do all in your power for its promotion.

I would, therefore, request you to communicate with such officers or private individuals in the colony under your Government, as may appear to you best qualified to furnish information on the subject, pointing out to them the service which they would render to science, by keeping journals of such phenomena as may come under their respective observations.

The form in which such journals should be kept is suggested in the memorandum herewith enclosed.

If you should succeed in setting on foot a system of observations, you will have the goodness to transmit to her Majesty's Government, half yearly, an abstract of the journals at your command; and I would suggest

that you should endeavour, as much as possible, to obtain authentic information of the same nature from the foreign countries in your neighborhood.

I have, &c.,

(Signed) GLENELG.

Memorandum respecting the records to be kept of the state of the weather in British Colonies.

The captains of ports, harbor masters, and keepers of light-houses, or where those officers do not exist, some other competent public functionary should be requested to keep journals of the weather, on the principle of the log-books of ships. A column should be specially reserved for inserting the hight of the barometer.

Under the head of "Remarks," should be entered all Meteorological Observations considered worthy of particular notice.

When a keeper of a journal may hear that a vessel has encountered a storm, he will enter in it any information on the subject which he can rely on, together with the name of the ship, of her owner, and of the port to which she may belong.

With the view of tracing the course of storms, the Trinity Board of London have given directions for the adoption of measures to obtain a more accurate record of the state of the weather, than has hitherto been kept at the light houses of Great Britain and Ireland.

The keepers of these lights having the opportunity of taking their observations, by night as well as by day, great advantage may be derived from employing them in this manner. Officers in charge of colonial light-houses, should be instructed to keep similar journals. In noting the wind's force, both in the harbor masters' journals and in the light-house reports, it is desirable that the officers should adopt the numbers for denoting the strength of the wind in use at Greenwich Observatory, and about to be introduced at the light-houses under the Trinity Board.

In the cases of St. Helena and Ascension, it is desirable that more precise information respecting the "Rollers at those Islands should be obtained.

As the object of Her Majesty's Government, in instituting these inquiries, is the advancement of knowledge or science generally, the Governors of the several British Colonies will consider how far it may be in their power to obtain useful information bearing on the subject, from countries adjoining to their Government in the possession of foreign powers, or how far it may be useful to the study of meteorology, to exchange the observations made within their Governments, for those of other countries in the neighborhood.

If at any time desired, there would be no objection to the publication in the colonial newspapers of extracts from the journals."*

I have deemed the foregoing necessary to a proper understanding of the question herewith submitted to the sea-faring, meteorological and scientific communities of the world, and for the information of all others, upon whose co-operation and assistance, the successful accomplishment of the important objects in view, depends.

*See pp. 23-28—Appendix to Instructions for taking Meteorological Observations at the Principal Foreign Stations of the Royal Engineers.

It will be observed that the meteorologists and Government of Great Britain have already taken steps for enlisting a large corps of laborers in the meteorological field, and that the American proposition is offered only as an amendment thereto.

To make the system complete, it appeared necessary to spread it out over the sea, as well as the land; and to secure the requisite concert of action among observers in all countries, it was thought advisable to propose a conference of meteorologists generally, at which the kind and construction of the instruments to be used, the subjects of observation, the time and method of observing, with the forms for recording and reducing the observations, &c., may be discussed and arranged; and at which, also, all the arrangements for a universal system of observation, including a series for the sea as well as for the land, may be made, and the plans for carrying it out recommended for the approval and adoption of those upon whose co-operation the successful prosecution of the scheme must rely. It is proposed that this conference shall be as general as is the field of research; and, therefore, it is desired that all those who have it in their power to assist, will take part in its proceedings either by personal representation or written communication, as to them may seem best.

The time and place for holding this conference, have not been agreed upon; but as soon as they are, they will be made known. In the mean time, communications have been addressed to the diplomatic functionaries of the various Governments represented near Washington, requesting them to bring the subject to the notice of their Governments. The replies of these gentlemen are encouraging; they give reason to expect that their Governments will give the proposition a favorable consideration.

After the details of the plan shall have been agreed upon in conference, it is supposed that the parties therein represented will co-operate in giving effect to the plan, by directing the observations to be made according to it, on board public ships, at military posts, at light-houses, hospitals and all other government establishments and institutions at which it may be convenient or desirable to institute a series of meteorological observations.

But, as important as such a co-operation on the part of Governments, would be, and as greatly to be desired as it is, that co-operation would by no means cover the whole ground; nor would the corps of laborers thus brought into the field, though every State in Christendom should unite in the scheme, be sufficient to gather the harvest that it is proposed to reap.

The plan, though it fully recognizes the value of the aid which Governments can give, by no means overlooks the importance of that kind of co-operation and aid which is to be derived from the hearty good will of good men, and from the voluntary co-operation of that powerful corps of Meteorological observers and navigators who labor in the private walks of life.

"Man is a Meteorologist by nature;" and every one who observes the wind and the weather, and who is in the habit of noting the thermometer and the barometer, is already an observer whose services it is desirable to secure, and whose labors in the field meteorological, the plan in contemplation proposes to make available. In like manner "all who go down to the sea in ships," are invited to co-operate: for they, too, are observers. That this immense corps of laborers who are already in the field should act in concert and "pull together," is

the object of the present plan. Therefore, the men of science, the scientific societies, the ship owners and ship masters, the directors of corporations, and the faculties of universities, and the members of the various institutions for the promotion of science, and good men everywhere, are requested to lend this scheme their good will, their influence, their aid, and their co-operation.

The importance of concert among Meteorologists all over the world, and of co-operation between the observer on the shore and the navigator at sea, so that any meteorological phenomenon may be traced throughout its cycle both by sea and land, is too obvious for illustration, too palpable to be made plainer by argument. And therefore the proposition for a general conference to arrange the details of such a comprehensive System of observations, addresses itself to every friend of science and lover of the useful in all countries.

The domain of this science is the atmosphere: its boundaries embrace the land and cover the sea. To comprehend the laws which govern the movements of a machine so vast as it is, requires that its operations should be observed in all its parts, and watched from all points at the same time. Its motions are freer and less obstructed over the water than they are by the land and across the mountains Indeed, the ocean itself may, in one sense, be regarded as a grand expression of meteorological agencies; therefore the good-will and friendly co-operation of private ship-owners and masters, in all maritime countries, is considered of great importance to the cause in hand.

Many of these in America have already shown their willingness to enter this field as co-laborers. Several hundreds of them are already co-operating with me in a system of observations according to a prescribed form, and from which several highly important results, both practical and scientific, have already been obtained. It is presumed that the ship-owners and masters of other countries will be equally as willing, and equally as zealous to second and to take part in such a system of observations as those of America have shown themselves to be.

These observations at sea possess a double value: they help us, as do those on the land, to a right understanding of the meteorological machinery of the earth; and they also help us in the safe navigation of the seas and in the industrial pursuits of commerce.

By how much the commercial marine of every country is more extensive than its naval, by so much more valuable is the assistance which the former is capable of rendering. How far are the owners and masters of the private ships under the various flags, inclined to furnish their vessels with the necessary instruments—to use them—to record the observations all according to the same form—and at the end of each voyage, to transmit them to the Repository that may be designated to receive them?

Upon the answer which the sea-faring community of each nation, shall give to this question, depend the importance of the aid, and the value of the co-operation which they will render in this undertaking. If they will but unite in one long pull together, the ocean, at their word, may be covered with floating observatories, each one, without interruption to owners or inconvenience to master, propounding as he goes, the same questions to nature; and all of them may, at the same instant, though scattered over the whole face of the earth, be extracting and recording her answers thereto.—These answers when brought together, compared and sifted, cannot fail to reveal truths and principles of the highest interest to mankind.

The missionaries who are stationed among the islands and in heathen lands, form also a class capable of rendering the most valuable assistance in any comprehensive system of meteorological observations. As a corps of observers they are not to be excelled—they visit parts of the world which cannot be brought under the system except through their instrumentality. While teaching savage man the principles of Christianity, and spreading around him the blessings of civilization, these devout men have also rendered most important services to the cause of science; and it is not doubted that when such a subject as this shall be brought to their notice, they will gladly lend it co-operation also.

Such are the classes and the individuals for whose consideration I now submit the proposition for a universal system of meteorological observations, for concert of action between the navigator at sea and the observer on shore, and for a general conference in which all the details connected with such a system shall be discussed and arranged.

As before stated, the subject has been brought officially before the various governments through the regularly appointed channels of communication. They have been invited to assist and co-operate.

It is proposed, therefore, before taking any definite action either as to the further details, or as to the time and place for holding the conference, to wait for the replies to these communications. In the mean time, however, I avail myself of this means of bringing the subject to the notice of the meteorologists, navigators, and the friends of science generally, with the hope that thereby the cause will be advanced, and that all whose good will, friendly councils, and co-operation are concerned, will take the matter into consideration, and be prepared to lend their support to a scheme which has for its object nothing but universal good.

To prevent misconception, it is proper to state that the plan proposed is based upon the principle of voluntary co-operation, and that I have no authority to pledge the Government of the United States for any expense whatever.

All of which is respectfully submitted,

M. F. MAURY,

*Lieut. U. S. N.**

U. S. N. Observatory,

December, 13, 1851."

Brazil, Chili, Peru, New Granada, Sardinia, the King of the Sandwich Islands, the Holy See, and Denmark, with many Scientific Societies and learned philosophers, readily responded to the proposition, and appointed representatives with whom I might consult as to details.

But when the original proposition, as amended by the American Government to include the sea also in the system of research, went back to the British Government, it was by that Government referred to the President and Council of the Royal Society for a report.

*Vide the pamphlet "on the establishment of an Universal System of Meteorological Observations, by sea and land"—published at the National Observatory, 1851.

This gave the subject a new aspect, as will appear from the following:

April 29th, 1852. At a Council of the Royal Society:

Present—The Earl of Rosse, President, in the Chair. Mr. Bell; Mr. Bowman; Mr. Brooke; Prof. Challis; Mr. Christie; Dr. Clark; Sir Philip Edgerton, Bart.; the Dean of Ely; Mr. Gassiot; Sir John F. Herschel, Bart.; Professor Miller; Lieut.-Col. Portlock, R. E.; Colonel Sabine, R. A.; Mr. Solly; Mr. Spence; Capt. Smyth, R. N.

The Minutes of the last meeting were read and confirmed.

Colonel Sabine reported that the Committee to which Mr. Addington's letter and the accompanying documents were referred, had agreed upon the following draft of a letter to be addressed to Mr. Addington by the Secretary.

"Somerset House, *May*, 1852.

"Sir:—I have the honor to acknowledge the receipt of your letter of March the 4th, transmitting, by direction of the Earl of Malmesbury, several documents received from foreign governments in reply to a proposal made to them by Her Majesty's Government, for their co-operation in establishing a uniform system of recording meteorological observations, and requesting the opinion of the President and Council of the Royal Society in reference to a proposition which has been made by the Government of the United States, respecting the manner in which the proposed co-operation should be carried out.

"Having submitted your letter with its enclosures to the President and Council of the Royal Society, I am directed to convey to you the following reply.

"With reference to the subject of well-directed and systematically conducted meteorological observations generally, and to the encouragement and support to be given to them by the governments of different countries, the President and Council are of opinion that they are highly deserving of such consideration, not only for their scientific value, but also on account of the important bearing which correct climatological knowledge has on the welfare and material interests of the people of every country.

"With reference to the proposal for the establishment of a uniform plan in respect to the instruments and modes of observation, the President and Council are not of opinion that any practical advantage is likely to be obtained by pressing such a proposition in the present state of meteorological science. Most of the principal governments of the European Continent, as Russia, Prussia, Austria, Bavaria and Belgium, have already organized establishments for climatological researches in their respective states, and have placed them under the superintendence of men eminently qualified by theoretical and practical knowledge, and whose previous publications had obtained for them a general European reputation. Such men are Kupffer, Dove, Kriel, Lamont and Quételet; under whose direction the meteorological observations in the above-named countries are proceeding; the instruments have been constructed under their care, and the instructions drawn up and published by them under the sanction of their respective governments. The observations as they are made are sent to them, are reduced and co-ordinated under their superintendence, and are published at the expense of the

governments. Every year is now producing publications of this nature in the countries referred to, and by the rapid intercommunication of these, the results of the experience of one country and the modifications and improvements which experience may suggest, become quickly known to all. To call on countries already so advanced in systematically conducted meteorological observations to remodel their instructions and instruments, with a view of establishing uniformity in these respects, would probably, if pressed, elicit from other governments also the reply which her Majesty's Government have received from Prince Schwarzenberg, conveyed in the Earl of Westmoreland's letter to Viscount Palmerston, viz: the transmission of a copy of the instructions which have been given to the Meteorological Observatories, forty-five in number, in the Austrian dominions, and a reference to the results obtained at those observatories, which are stated to be in regular course of publication.

"In an earlier stage, when these establishments were either forming or were only in contemplation, it was considered that advantage might arise from a discussion of the objects to be principally kept in view, and of the instruments and methods by which these might be most successfully prosecuted. For this purpose, a conference was held at Cambridge, in England, in 1845, which was attended by many of the most distinguished Meteorologists in Europe, and amongst them by all the gentlemen whose names are above stated, and who were expressly sent by their respective governments. The impulse communicated by this assemblage was without doubt highly beneficial, and the influence of the discussions which took place may perhaps be traced in some of the arrangements under which the researches in different countries are now proceeding; but in the stage to which they have advanced, it may be doubted whether any measures are likely to be more beneficial than those which would increase the facilities of a cheap and rapid intercommunication of the results of the researches which are in progress.

"With reference 'to the suggestions made by the scientific men of the United States,' "the proposition of Lieutenant Maury, to give a greater extension and a more systematic direction to the meteorological observations to be made at sea, appears to be deserving of the most serious attention of the Board of Admiralty. In order to understand the importance of this proposition, it will be proper to refer to the system of observations which has been adopted of late years in the navy and merchant service of the United States, and to some few of the results to which it has already led. Instructions are given to naval captains and masters of ships, to note in their logs the points of the compass from which the wind blows, at least once in every eight hours: to record the temperature of the air, and of the water at the surface, and when practicable, at considerable depths of the sea: to notice all remarkable phenomena which may serve to characterize particular regions of the ocean, more especially the direction, the velocity, the depths and the limits of the currents: special instructions also are given to whalers, to note down the regions where whales are found, and the limits of the range of their different species. A scheme for taking these observations regularly and systematically, was submitted by Lieut. Maury to the Chief of the Bureau of Ordnance and Hydrography, in 1842, and instantly adopted: detailed instructions were given to every American shipmaster, upon his clearing from the Custom House, accompanied by a request that they would transmit to the proper office, after their return from their voyage,

copies of their logs, as far at least as they related to these observations, with a view to their being examined, discussed and embodied in charts of the winds and currents, and in the compilation of sailing directions to every port of the globe. For some years the instructions thus furnished received very little attention, and very few observations were made or communicated; the publication, however, in 1848, of some charts, founded upon the discussion of the scanty materials which had come to hand or which could be collected from other sources, and which indicated much shorter routes than had hitherto been followed to Rio and other ports of South America, was sufficient to satisfy some of the more intelligent shipmasters of the object and real importance of the scheme, and in less than two years from that time it had received the cordial co-operation of the masters of nearly every ship that sailed. At the present time there are nearly 1000 masters of ships who are engaged in making these observations; they receive freely in return the charts of the winds and currents, and the sailing directions which are formed upon them, corrected up to the latest period.

"Short as is the time that this system has been in operation, the results to which it has led have proved of very great importance to the interests of navigation and commerce. The routes to many of the most frequented ports in different parts of the globe have been materially shortened, that to St. Francisco in California by nearly one-third: a system of southwardly monsoons in the equatorial regions of the Atlantic and on the west coast of America has been discovered; a vibratory motion of the trade-wind zones, and with their belts of calms and their limits for every month of the year, has been determined; the course, bifurcations, limits and other phenomena of the Great Gulf-stream have been more accurately defined, and the existence of almost equally remarkable systems of currents in the Indian Ocean, on the coast of China, and on the North-western coast of America and elsewhere has been ascertained; there are, in fact, very few departments of the science of meteorology and hydrography which have not received very valuable additions; whilst the most accurate determination of the parts of the Pacific Ocean (which are very limited in extent), where the sperm-whale is found, as well as the limits of the range of those of other species, has contributed very materially to the success of the American whale fishery, one of the most extensive and productive of all the fields of enterprise and industry.

"The success of this system of co-operative observations has already led to the establishment of societies at Bombay and Calcutta, for obtaining, by similar means, a better knowledge of the winds, currents, and the course of the streams of the Indian seas.

"But it is to the government of this country that the demand for co-operation, and for the interchange of observations, is most earnestly addressed by the government of the United States; and the President and Council of the Royal Society, express their hope that it will not be addressed in vain. We possess in our ships of war, in our packet service and in our vast commercial navy, better means of making such observations, and a greater interest in the results to which they lead, than any other nation; for this purpose, every ship which is under the control of the Admiralty should be furnished with instruments properly constructed and compared, and with proper instructions for using them: similar instructions for making and recording observations, as far as their means will allow, should by given to every ship that sails, with a request that

they will transmit the results of them to the Hydrographer's Office of the Admiralty, where an adequate staff of officers or others should be provided for their prompt examination, and the publication of the improved charts and sailing directions to which they would lead; above all, it seems desirable to establish a prompt communication with the Hydrographer's Office of the United States, so that the united labors of the two greatest naval and commercial nations of the world may be combined, with the least practicable delay, in promoting the interests of navigation.

"The President and Council refer to the documents which have been submitted to them, and more especially to the 'Explanations and Sailing Directions to accompany wind and current charts' prepared by Lieutenant Maury, for a more detailed account of this system of co-operative observations, and of the grounds upon which they have ventured to make the preceding recommendations."

(Signed) "S. HUNTER CHRISTIE, Sec. R.S."

"*H. U. Addington, Esq.*"

"Resolved,—that this report be adopted, and that the Secretary be requested to write a letter to the effect, approved by the Committee."

Report of Lieutenant Maury to the Secretary of the Navy.

NATIONAL OBSERVATORY, *Washington, November 6th*, 1852.

SIR:—By a communication of December 6th, 1851, from the Navy Department, I was instructed to confer with Her Britannic Majesty's officers and others, with regard to the establishment of a universal system of meteorological observations. I was directed also to report progress from time to time to the Navy Department. This I now have the honor to do.

That no time might be lost with regard to a measure that gives promise of such universal benefits, I immediately published a pamphlet in explanation of the proposition and of the steps which had been taken with regard to it.

A copy of this pamphlet entitled "On the establishment of a universal system of meteorological observations by sea and land," I have the honor herewith to forward.

Steps were taken to bring the subject to the notice of the various Governments with which the United States were in friendly and diplomatic intercourse. To this end, Ministers and Diplomatic Agents were addressed, requesting them to bring the subject to the notice of the proper functionaries abroad, and to convey an invitation for co-operation.

The main object of this plan of meteorological observations, so far as the aim which the United States had especially in view is concerned, was to bring the sea regularly within the domain of active and systematic meteorological research, and make it a field in which maritime nations might all act together and in concert for the common good of mankind.

This proposition was offered as an amendment to one from Great Britain, inviting the co-operation of the United States in an arrangement "for the purpose of enabling the officers of the Royal Engineers at foreign stations to take meteorological observations upon an uniform plan."

At the time that this amendment was offered, it was not known here that the Government of Great Britain had invited the co-operation of other Governments generally in the plan which she had proposed for the "nineteen stations" of her Royal Engineers.

Moreover, as the proposition to establish a uniform plan of making and recording meteorological observations on shore, seems to meet with more or less opposition among meteorologists, I would recommend that the United States should afford, as far as practicable, the co-operation asked for by Great Britain in the first place; abandon, for the present at least, that part of the "universal system" which relates to the *Land*, and direct our efforts mainly to the Sea, where there is such a rich harvest to be gathered for commerce and navigation, as well as for the increase of knowledge, the advancement of science, and the benefit of man.

I am further induced to make this recommendation in consequence of the evident reluctance with which Russia, Austria, Bavaria, Belgium and other powers, seem to regard any change in their system of meteorological observations on shore, and under which some of their *savans*, as Dove, Kriel, Lamont, Quételet, *et al.*, have obtained a world-wide reputation.

On the Land, the field is already well filled with laborers: it has been occupied for a long time, and each country seems to have adopted a system of its own, according to which its laborers have been accustomed to work, and to which its meteorologists are more or less partial.

Any proposition having in view, for these systems, a change so radical as to bring them to uniformity, and reduce them to one for all the world, would, I have reason to believe, be regarded with more or less jealousy by many; and though there be not a few societies and individuals of great eminence and worth, such as the Academy of Sciences of France, the Meteorological Society of Great Britain, and the Royal Danish Society of Sciences, that have manifested a readiness to entertain propositions to such an effect: yet Meteorology is a science, which depends so much for progress, upon harmony, co-operation and mutual accord of observers, that I have deemed it expedient not to press observers on the land for any co-operation with observers at sea, except such as they will willingly give in their own way, and according to their own plan.

Independent of these considerations, there is another, which should be paramount in inducing us not to press the proposition for a universal system of Meteorological Observations on the land, and a general co-operation of Meteorologists therein:

The British Government, which had taken the lead in that feature of the plan, upon the receipt of the American proposition to include the sea also, and make the plan universal, referred the subject to the President and Council of the Royal Society for a report.

That Society, at its sitting of the 29th of April last, adopted a report upon the subject which had been brought before it by command of the Earl of Malmesbury, in which "with reference to the proposal for the establishment of a universal plan, in respect to instruments and modes of observations" *on the land*, the opinion is expressed, that no "practical advantage is likely to be obtained by pressing such a proposition, in the present state of Meteorological Science."

Bowing to the authority and weight of this opinion—respect for the source whence it emanates, and a

proper regard for the circumstances under which it was called forth, seem to render any further action, with regard to the land feature of the plan, highly inexpedient, not to say indelicate, and therefore improper, on our part.

Not so, however, with regard to the sea; that meets with decided favor and earnest support.

In the report already alluded to, the President and Council of the Royal Society hold the following language with reference to the suggestions made by the scientific men of the United States: "The proposition of Lieut. Maury to give a greater extension and a more systematic direction to the meteorological observations to be made at sea, appears to be deserving of the most serious attention of the Board of Admiralty. In order to understand the importance of this proposition, it will be proper to refer to the systems of observations which have been adopted of late years in the Navy and Merchant service of the United States, and to some few of the results to which it has already led. Instructions are given to Naval captains and masters of ships, to note in their logs the points of the compass from which the wind blows, at least once every eight hours; to record the temperature of the air, and of the water at the surface, and when practicable, at considerable depths of the sea; to notice all remarkable phenomena which may serve to characterize particular regions of the ocean, more especially the direction, the velocity, the depth and the limits of the currents. Special instructions also are given to whalers to note down the regions where whales are found, and the limits of the range of their different species. A scheme for taking these observations regularly and systematically, was submitted by Lieut. Maury to the Chief of the Bureau of Ordnance and Hydrography, in 1842 and instantly adopted. Detailed instructions were given to every American ship-master, upon his clearing from the Custom-house, accompanied by a request that they would transmit to the proper office, after their return from their voyage, copies of their logs, so far at least, as they related to these observations, with a view to their being examined, discussed, and embodied in charts of the winds and currents, and in the compilation of sailing directions to every part of the globe. For some years the instructions thus furnished received very little attention, and very few observations were made or communicated; the publication, however, in 1848, of some charts, founded upon the discussion of the scanty materials which had come to hand, or which could be collected from other sources, and which indicated much shorter routes than had hitherto been followed to Rio, and other parts of South America, was sufficient to satisfy some of the intelligent ship-masters of the object and real importance of the scheme, and in less than two years from that time it had received the cordial co-operation of the masters of nearly every ship that sailed. At the present time, there are nearly 1000 masters of ships engaged in making these observations; they receive freely in return the charts of the winds and currents, and the sailing directions which are framed upon them, corrected up to the latest period.

"Short as the time that this system has been in operation, the results to which it has led have proved of very great importance to the interests of navigation and commerce. The route to many of the most frequented ports in different parts of the globe have been materially shortened; that to San Francisco, in California, by nearly one third. A system of southwardly monsoons in the equatorial regions of the Atlantic and on the west coast of America has been discovered; a vibratory motion of the trade-wind zones and with their belts

of calms and their limits for every month in the year determined; the course, bifurcation limits, and other phenomena of the Gulf stream have been more accurately defined, and the existence of almost equally remarkable systems of currents in the Indian Ocean, on the coast of China, and down the west coast of America and elsewhere has been ascertained. There are, in fact, very few departments of the science of Meteorology and Hydrography which have not received very valuable additions; whilst the most accurate determination of the parts of the Pacific ocean (which are very limited in extent) where the sperm whale is found; as well as the limits of the range of those of other species, has contributed very materially to the success of the American whale fishery, one of the most extensive and productive of all the fields of enterprise and industry.

"The success of this system of co-operative observation has already led to the establishment of societies in Bombay and Calcutta for obtaining by similar means, a better knowledge of the winds, the currents, and the course of the streams of the Indian Ocean.

"But it is to the government of this country, that the demand for co-operation, and for interchange of observations, is most earnestly addressed by the Government of the United States; and the President and Council of the Royal Society express their hope that it will not be addressed in vain.

"We possess in our ships-of-war, in our packet service, and in our vast commercial navy, better means of making such observations, and a greater interest in the results to which they lead, than any other nation; for this purpose every ship which is under the control of the Admiralty, should be furnished with instruments properly constructed and compared, and with proper instructions for using them: similar instructions for making and recording observations, as far as their means will allow, should be given to every ship that sails, with the request that they will transmit the results of them to the Hydrographical Office of the Admiralty, where an adequate staff of officers or others, shall be provided for their prompt examination, and the publication of the improved charts and sailing directions, to which they lead: above all it seems desirable to establish a prompt communication with the hydrographers of the United States, so that the united labors of the two greatest naval and commercial nations of the world may be combined, with the least practicable delay, in promoting the interests of navigation.

"The President and Council refer to the documents which have been submitted to them, and more especially to the explanations and sailing directions to accompany wind and current charts, prepared by Lieutenant Maury, for a more detailed account of this system of co-operative observations, and of the grounds upon which they have ventured to make the preceding recommendations."

Moreover, at the last meeting of the British Association, held a few weeks ago, its President in his address remarked: "The activity which has prevailed so greatly of late, in the collection of Meteorological data, has been almost exclusively confined to that portion of the surface of the globe which is occupied by land, although the portion covered by the ocean, is not only much greater in extent, but is also better suited for the solution of several Meteorological problems.

"Many striking examples might be adduced to show that it is systematic direction, and not individual zeal, in naval men which has been wanting, *and it has been therefore, with great satisfaction, that Meteorologists*

have learned that a proposition has been made, from the United States Government, conjointly, and in co-operation, a system of Meteorological observations to be made at sea, in all ships belonging to the naval service of the two countries, and sufficiently simple to be participated in by the merchant service also.

"In a partial trial which has already been made in the United States, it has been found to produce results which, exclusive of their scientific bearing, *are of great importance to the interests of navigation and commerce, in materially shortening passages*, by the knowledge of prevailing winds and currents, at particular seasons." "The practical advantage arising from the co-ordination of the observations in the Hydrographic office of the United States, and the circulation of the charts of the winds and currents and the sailing directions founded on them, have been such, and so appreciated, that there are now as is stated, more than 1,000 American ships engaged in making them. The request for British co-operation in an undertaking so honorable to the country in which it originated, was referred in the Spring of this year by the Earl of Malmesbury to the President and Council of the Royal Society for a report. * * * * * * * * Doubtless we can now estimate only a small part of the advantages which terrestrial physics, as well as hydrography and navigation would derive from the concurrent exertions of the two great maratime nations, in the way which has been pointed out."

Such are the reasons and the circumstances which induce me to recommend an abandonment, for the present, of the land portion, and to urge further action with regard to that which includes the sea. This meets the approval of all who have expressed opinions with regard to it; many, great and obvious are the advantages which it promises to navigation and commerce, and all that seems wanting now to get it fairly underway is the adoption of the necessary preliminary arrangements.

These relate chiefly to the subjects of observations, the instruments to be used, and the modes and methods of making the observations and of treating them. The abstract logs, as the forms used by the American ship-masters for making and recording observations at sea, for this office, are called, were intended principally for the commercial marine; and therefore they only embrace such objects, and require only such instruments as the masters of American merchant vessels generally are accustomed to use and to make.

These observations have been carried far enough to show the great need there is for nicer instruments, for more accurate observations, and for including among the objects to be observed, certain things which are generally passed over unobserved by navigators.

As it is desired, therefore, that the navies of all maratime nations should co-operate and make these observations in such a manner and with such means and implements, that the system may be uniform, and the observations made on board one public ship be readily referred to and compared with the observations made on board all other public ships, in whatever part of the world;—And moreover, as it is desirable to enlist the voluntary co-operation of the commercial, as well as the military marine of all nations, in this system of research, it becomes not only proper, but politic, that the forms of the abstract logs to be used, the description of the instruments to be employed, the things to be observed, with the manipulation of the instruments, and the methods and modes of observation should be the joint work of the principal parties concerned.

Wherefore, in discussing the requisite forms and instructions for this purpose, I should be glad to have the assistance in counsel and advice of the most eminent navigators.

For these reasons I request that the Board of Admiralty, and the Ministers of Marine of France, Russia, Holland, Denmark, Sweden and Prussia, be invited, each to appoint for this purpose, an officer to meet me at such time and place as shall be agreed upon.

Respectfully, &c.,
M. F. MAURY,
Lieut. U. S. Navy.

Hon. JOHN P. KENNEDY,
Secretary of the Navy, Washington.

Waiting for a reply to this communication, to return to the Indian Ocean.

The materials which I have from that ocean, and which have been furnished by American navigators, at present engaged in its commerce, are just sufficient to show that there is a rich harvest to be gathered there.

A Gulf Stream, nearly if not quite equal to our own in the Atlantic, has its genesis there. Its waters are nearly at blood heat; they frequently reach a temperature of 90°. Between the shores of China and one of the sources of this hot stream, but counter to it, is a current of cold water.

In this system of aqueous circulation thus detected, and in the prevailing winds of the Pacific, are to be found the conditions which cause the climates of the Atlantic States to be repeated along the coasts of China; the climate of Western Europe to be reduplicated in Northwestern America. Here in the tepid waters of India which this stream conveys towards the Fox Islands—the Newfoundland of the Pacific ocean—is to be found the origin of the fogs of the North Pacific, and the European-like climate of Oregon. It may be expected that the storms which take their rise near the western margin of the Pacific ocean will also follow this stream in their course.

The passage from China to San Francisco is now made in 54 days. But with the knowledge which these Charts promise us, with regard to this stream and the winds of that ocean, there is reason to believe that the average passage under canvass may be yet still further, and considerably reduced.

There is a part too of the North Pacific which answers to our Sargasso sea of the Atlantic. In it, sea-weed and drift-wood will probably be found, though not in such quantities as in the Atlantic. I have already received some information concerning a sort of Sargasso sea in the Pacific.

Bottles containing a paper with the date and place of the ship, and requesting the finder to cause the same to be published in the nearest newspaper, and forwarded to the Superintendent of the National Observatory, at Washington, with an account of the time and place at which it may be picked up, would, in many cases, afford much useful, valuable and interesting information concerning the currents of the Pacific Ocean.

The practice of throwing bottles thus freighted overboard in that and the Indian Ocean is recommended to navigators who are co-operating with me in these investigations. and a frequent resort to this practice is earnestly commended to their attention.

The Indian ocean is the fountain of another stream of warm water which flows South, and a branch of which is the well known Lagullas current.

With the information to be derived from the Abstract Log-books with which I hope *every* American navigator that visits those seas will furnish me, I see reason for the anticipation of great improvements in the navigation there—particularly in the navigation between New Holland and India; and between India, China, and the Cape of Good Hope.

The discovery has already been made, that in certain parts of the China seas, each month almost has a system of winds peculiar to itself. Thus the winds between the parallels of 15° and 20° N., and the meridians of 110° and 115° E. are:

In Dec., between	N. and N. E. inclusive.
Jan.,	N. and E.
Feb.,	N. N. E. and E.
March and April,	N. E. and S. E.
May,	N. by way of E. to S. W.

Lat. 5° and 10° N., Long. 105° and 110° E.

April,	between	N. E. and E. inclining to v'bl.
May,		around the Compass.
June,	between	S. E. and S. W.
July,	"	S. and S. W.
June,	between	S. E. and S. S. W.
July,	"	S. and S. W.
August,	"	S. and W. S. W.

Sept.,	around the Compass.
Oct. and Nov., btw.	N. and E.

5° and 10° N. 105° and 110° E.

Dec., Jan. & Feb., btw.	N. and N. E.
March,	steady from N. E.
Aug. and Sept., btw.	S. and W. N. W.
Oct. and Nov.	Variable, around the Compass. *See plate* 1.

Lat. 15° and 20° N., Long. 115° and 120° E.

Dec. to April, btw.	N. and E.
May and June,	Variable.
July and Aug., btw.	S. S. W. and S. W.
Sept. and Oct.,	Variable.

These facts have been clearly brought out by these investigations; and that such are the differences with regard to the winds in different parts of this ocean, and at different seasons of the year, there is no more doubt than there is as to the fact that the monsoons change.

Some few masters of merchantmen, I am aware, have refused or withheld co-operation in this undertaking upon the plea that I have some theory of my own which I am seeking to build up by these charts.

They are mistaken; I set out with no theory; and I have none to build up. I set out with the view of collecting facts, of gathering and presenting side by side the experience of every navigator with regard to the winds and currents, and the phenomena of the sea—of taking the records thereof from all the Log books I could obtain—and of discussing them, that I might ascertain not from the reports of one or two seamen, but of a multitude, the prevailing winds for every month in every part of the ocean; and in the manner of doing this, I have been governed altogether by the principles of inductive philosophy.

And to satisfy navigators as to the confidence which is due the results thus obtained and announced, I will explain the process by which those above quoted as to the winds in the China sea, were obtained; for

this purpose I present for their examination a fac simile taken from the sheet upon which Lieut. Forrest is engaged in marking the direction of the winds recorded in their Logs.

The entire ocean is divided into districts of 5° of lat. by 5° of long. each, and in whatever part of one of these districts a navigator may be when he records the direction of the wind in his Log, from that direction the wind is assumed to be blowing at that time all over that district; and this is the only assumption that is permitted in the whole course of investigation.

Now if the navigator will draw, or imagine to be drawn, in any such district, 12 vertical columns for the 12 months—and then 16 horizontal lines through the same district for the 16 points of the compass, i. e. for N., N.N. E., N. E., E. N. E., and so on, omitting the *by*-points, he will have before him a picture of the " investigating Chart," out of which the "Pilot Charts" are constructed. In this case, the alternate points of the compass only are used; because when sailing free, the direction of the wind is seldom given for such points as N. by E., W. by S., &c. Bearing this in mind, the intelligent navigator will have no difficulty in understanding the annexed diagram, (Plale 1;) and in forming a correct opinion as to the degree of credit due to the results afforded by it.

Instead of entering the wind in the Log as from the *point* of the compass from which it blows, many seamen were too much in the habit, particularly when the wind is a little variable, to enter it as from the "Sd. and Wd.," "Nd. and Ed.," and so on, by quadrants.

In such cases, the officers who are conducting the investigations are at a loss to know how to enter such winds on the sheet; they do not know in the case of the entry "Nd. and Ed.," for example, whether to enter it on the N. N. E., the N. E. or the E. N. E. line, for these are all " Nd. and Ed."

As soon as the attention of those who were keeping abstracts for me was called to this, they with great promptitude and fidelity, I have reason to believe, remedied the defect and adopted the plan recommended, by entering the wind for the first, middle, and latter part—3 times a day—as from the point of the compass from which it most prevailed during each part. Thus three entries or scores are made on the sheet for every day—these scores are made in the column standing for the month, and on the line standing for the point of the compass from which the wind prevailed.

As the compiler wades through Log book after Log book, and scores down in column after column, and upon line after line, mark after mark, he at last finds that under the month and from the course upon which he is about to make an entry, he has already made four marks or scores thus : (IIII). The one that he has now to enter will make the fifth, and he " scores and tallies ;" and so on, until all the abstracts relating to that part of the ocean upon which he is at work has been gone over, and his materials exhausted. These "fives an tallies" are exhibited on Plate 1.

He then sums up the number of winds entered from each point for each month, and enters the same—expressed in figures—in its appropriate place on the "Wind-rose" of the Pilot chart. Plate V.

The course of the winds as given in the abstracts are compass courses, and they are entered on his working sheet accordingly. For example: if the variation be more than one point, and less than three, the compiler, when he goes to transfer results to the Pilot Chart, makes the correction for all at once, by allowing for two points of variation, so that the Pilot Chart may shew the true courses of the winds as nearly as possible

Thus, suppose that, in the district which the compiler is about to transfer, the variation be 2 points East; what he has recorded in his working sheet as north winds for instance, are transferred to the Pilot Chart as N. N. E. winds, and so on, correcting every course for variation. If the variation be one point or less, then the transfer is made without any correction.

Now with this explanation it will be seen that in the district marked A, (Plate 1,) there have been examined the logs of vessels that, giving the direction of the wind for every eight hours, have altogether spent days enough to enable me to record the calms and the prevailing direction of the wind for eight hours, 2,144 times:—of these, 285 were for the month of August; and of these 285 observations for August, the wind is reported as prevailing from N. 3 times; from N. N. E. 1; N. E. 2; E. N. E. 1; E. 0; E. S. E. 1; S. E. 4; S. S. E. 2; S. 24; S. S. W. 45; S. W. 93; W. S. W. 24; W. 47; W. N. W. 17; N. W. 15; N. N. W. 1; Calms (the little 0's) 5; total 285 for this month in this district.

Now the only questions to be asked and answered, as expressive of doubt with regard to these results are: were these observations made under the usual condition of things? And if so: are there enough of them to afford a fair average as to the prevailing directions of the winds in that district?

The Log Books are taken at random, examined with care and quoted with fidelity, and therefore, as the observations were made by mariners as they chanced to pass to and fro through this or that part of the ocean, the presumption is a fair one that their records shew fairly.

Are the observations sufficiently numerous to afford the data for a fair average?

The answer in this case depends upon the opinion of him who undertakes to reply; but to be sure of erring on the right side, if err I must, I have aimed to get at least, on the average, 100 observations for every month in every district. This is my aim, but practically I have found it difficult to accomplish it. In some districts I have obtained as many as 1800 observations for a single month; whereas, in another month in a neighboring district, I have not been enabled to obtain a single observation; and such is liable to be the case as long as some parts of the ocean, as there must be, are frequented more than other parts, or as long as crops come to market at different periods of the year, and commerce has its seasons of annually recurring activity and repose.

There is then this satisfaction to the practical navigator, when he sees a blank Wind-rose on the Pilot Chart: he wants most to use the parts of the ocean that are the most frequented and are the great highways, while those parts which lie out of the paths of commerce possess so little practical interest to him, that he does not care to know which way the wind blows there. The navigator, therefore, stands a very good chance of getting all he wants from these Charts—it is the philosopher who wishes to trace in "his circuit" the winds in the unfrequented parts of the ocean, and for his sake it is desirable to have records extending over all parts of the ocean and in all seasons alike.

But plate 1, incomplete as it is, affords much that is interesting to the philosophical navigator; though it has been said in high places that philosophical research and the pursuits of the sailor are incompatible: as seamen became philosophers they "lose the qualities and habits necessary for command at sea." So says one high in office, but who is no sailor, and therefore, no judge in such a case at least.

There is no calling of men who have done more for philosophy than mariners, and any one who will take the trouble to examine Plate 1, which is made up entirely of observations by this much abused class, will find it abounding with philosophical truths, principles and instruction. More than any other class, the sailor is accustomed to observe, upon the great deep, the workings of nature, and he, to be fit for his calling, must be a philosopher in the truest sense of the term.

Upon this Plate he sees marked out in the most beautiful and striking manner, the path of the "wind in his circuits" over the part of the ocean to which it relates. He perceives by examination that the law which governs the wind in district A is not the law which governs it in district B.

That in the former, the month of September is remarkable for the consistency and steadiness with which the wind clings to the S. W. quadrant. That in the latter, it is all around the compass for September, inclining to prevail most from the N. E. quadrant. After looking at A, he will conclude that every season of the year, winter, spring, summer and autumn, may be said there to have each its own monsoons or peculiar system of winds. The winds take almost from December to September, gradually to get round from northward and eastward, to southward and westward; and they leap back almost at a single bound, it may be said, in the month of October.

There are many other respects in which the philosophical navigator (and I hold every properly qualified navigator to be a philosopher) will find himself interested with regard to the statistics exhibited in this Plate.

The number expressed in figures denotes the whole number of observations of calms and winds together, that are recorded for each month and district.

In C, the wind in May *sets* one third of the time at West. But in A, which is between the same parallels, the favorite quarter for the same month is from S. to S. W., the wind setting one third of the time in that quarter, and only 10 out of 221 times from the west; or on the average, it blows from the West only $1\frac{1}{2}$ day during the month of May.

In B, notice the great "Sun Swing" of the winds in September, indicating that the change from summer to winter in that region, is sudden, violent; from winter to summer, gentle and gradual.

The proposition to collect a great number of Log-books with the view of patiently examining them all, one by one, of taking from each an exact account of the winds and currents mentioned, and of carefully collecting all the information to be gathered from such sources, touching the industrial pursuits of the sea, and of so presenting that information as to embody the united experience of every navigator, could not fail to commend itself most favorably to every intelligent and public spirited mariner. The manner in which shipmasters and owners finally received this proposition has been highly gratifying; and, on account of the co-operation which I have received at the hands of this class of my fellow citizens, the undertaking, though but just begun, has, nevertheless, been crowned with results which I dared not anticipate.

These results have been beneficial to commerce and navigation in a high degree. Wherever the Charts have been extended, there has been a great gain of knowledge as to winds, &c., consequently a shortening of voyages and a saving of time, by rendering passages to and fro less uncertain.

During the course of these investigations, facts, in many instances, have been elicited to confirm what philosophers already knew, and had proclaimed touching the winds and currents of the sea. In other instances, facts and circumstances have been revealed, which may be regarded as new, and in some cases as amounting to valuable if not important discoveries.

As all the results derived from these Charts, whether in confirmation of what was already suspected, or in evidence of increasing knowledge as to the laws of nature, have been obtained by a new and independent system of research, they, or the most striking of them, deserve to be enumerated, in order that the importance of the undertaking may be better appreciated by those upon whom I have called for help and co-operation.

These are some of them :

1st. The discovery of a new and better route hence to the equator.

2d. A system of southwardly monsoons in the equatorial regions of the Atlantic ocean.

3d. Ditto off the west coast of America in the Pacific.

4th. The vibratory motion of the trade wind zones, with their belts of calms.

5th. The limits of these have been determined, and the parallels between which those limits are to be found for any month, pointed out to the mariner.

6th. The fact has also been made clear, and brought within the compass of demonstration, that the S. E. trade winds are stronger than the N. E.; that they cover a broader belt on the ocean, and keep in motion a greater volume of atmosphere; that at a mean in the Atlantic, the breadth of the band of trade winds is about 22° for the N. E.; and 29° for the S. E.

7th. That in the general system of atmospherical circulation, the prevailing winds of the southern are stronger than the prevailing winds of the northern hemisphere.

8th. That the mean temperature of the northern is higher than that of the southern hemisphere.

9th. That the greatest density or specific gravity of the surface waters of the Atlantic ocean, is near the parallels of 17° North and of 15° South.

10th. The causes of the rainy and dry seasons, and the means of telling wherever on the Earth's surface, the seasons are so divided by nature.

11th. The parts of the ocean in which sperm and right whales most resort have been discovered and pointed out.

12th. The interesting fact in the natural history of this animal has been brought to light, viz: that the species known to fishermen as the right whale cannot cross the torrid zone.

13th. And that there is a species of whale peculiar to the Arctic ocean; and probably another to the coast of California.

14th. That in certain parts of the Indian ocean, the waters are warmer than in any other sea.

15th. That there is a cold current along the coast of China.

16th. And that there are many highly interesting and beautiful anomalies touching the Gulf Stream, the cold and warm currents of the sea, and the distribution of heat over the surface of the land and water, for an account of which, I refer to the Charts themselves.

I have intimation of other results: that if this system of interrogating nature touching the laws by which the circulation of the air and water is regulated, be patiently pursued, many instructive replies, and much information that is truly valuable will be elicited.

And in order to encourage the large corps of mariners who are co-operating in this work, I may be excused for enumerating some of the most striking of the probable results, which these investigations encourage us to anticipate, or induce us to inquire for.

1st. These investigations will probably show that the mean temperature of the ocean for any parallel is higher than that of the air for the same parallel at sea, even though a cold current be present.

2d. They afford room to suppose, and themselves suggest the supposition, that the air which the S. E. trade winds discharge into the belt of equatorial calms, after ascending there, flows for the most part over into the northern hemisphere; while that which the N. E. trades discharge into the same belt, passes in like manner over into the southern hemisphere.

3d. That the calms of Cancer and of Capricorn are caused by the meeting of two upper currents; the one from the Pole being dry, the other from the Equator being charged with vapor.

4th. That there is a region of calms near the poles in which the barometer on a level with the sea, probably stands lower than it does generally on the sea level of the earth; and the inquiry is suggested whether the magnetic pole be not within this region.

5th. That the trade wind regions are the evaporating regions; and that we ought to inquire whether the electricity displayed in our thunder storms does not come from the trade wind regions and go up into the clouds with the vapor from the sea.

6th. That the waters of the Mississippi River and the great American Lakes are rained from clouds, the vapor for which was taken up from the South Pacific Ocean, while the waters of the Amazon and Oronoco are evaporated exclusively from the Atlantic.

7th. That the springs in the ocean which supply the sources of all the great rivers of the northern hemisphere are, for the most part, to be found where the S. E. trade winds blow, in the Atlantic, Pacific and Indian oceans.

8th. That magnetism is probably an agent in giving direction to the circulation of the atmosphere; and the question is raised, if it be not concerned in the currents of the ocean also.

9th. That the "red fogs" of the Cape Verde Islands, and the so-called "African dust" of the North Atlantic, is dust from the basin of the Amazon and Oronoco, taken up by the winds in the dry seasons, and transported in the upper current from the equator towards the pole, that is counter to the N. E. trade winds. This "dust" is known to consist, for the most part, of infusoria, from the river basins of South America, and the microscopic examinations of Prof. Ehrenberg go far to prove that such is the origin of the "red fogs and sea dust."

10th. That the basin which holds the Gulf of Mexico, is a little over a mile deep, on the average* that

*See the deep soundings of the U. S. Ship "Albany," Commander Platt, and sounding journal of Lt. Wm. Rogers Taylor, U. S. N. in another part of this work.

the Carribbean sea in the deepest parts is nearly three miles, if no more; that the North Atlantic is more than 6 miles; the South at least three; and the Gulf stream in the Florida Pass, 500 fathoms deep.

11th. Agencies have been revealed which suggest the conjecture that at the head of the Red sea near the isthmus of Suez, the waters are lower, saltier and heavier, than they are near its mouth. That at its head there is a winter and a summer level, and that there is a strong under current from it into the Indian ocean.

12th. That the same whale is found in Behring's Straits, and Baffin's Bay, and the fact is proved that this fish cannot get from the one place to the other except through the Arctic Ocean.

I do not wish to be understood as claiming this catalogue of phenomena as actual results already derived from the investigations of Log Books; nor do I intend by this enumeration of them to commit myself with regard to them further than I have done in the body of this work. Whether they be regarded as questions for further research, as probabilities, as actual discoveries, or as confirmations of known truths, I have enumerated them for the purpose of showing those who are laboring in connection with this work, that the field is both rich and wide; that good use is made of the materials which are furnished; that the plan of treating these materials is a good one, because, resting on an independent and separate system of observations, the manner of discussion is such as to confirm almost all that was known before with regard to the winds and currents of the sea, and I have enumerated them for the purpose also of showing that though much that is valuable and important has been done, much that is inviting remains yet to be done.

Neither do I mean to embarrass this beautiful system of investigations by implying that all these indications are to be established, and all these questions to be answered in the affirmative. But inasmuch as they are indications and questions which mark the progress of the Charts, and which the Charts themselves have revealed or suggested, I expect the Charts will throw more light upon most of them, and enable us to give some conclusive answer, pro or con, with regard to them.

In a system of research such as this is, questions will arise, and there are many such which are continually pressing themselves upon the philosopher, to which a satisfactory answer, whether in the negative or the affirmative is equally desirable, and will be equally conducive to the great end in view, viz: progress in the collection of physical facts and advancement in studying the laws of nature. Such is the character of many of the questions which these Charts move us to propound.

For the materials from which these results have been obtained, or are promised, I am mainly indebted to the voluntary co-operation of American shipmasters and owners; for the results themselves, I am indebted, first to the countenance which the Navy Department and the Chief of the Bureau of Ordnance and Hydrography have extended to the work; and next to the fidelity and zeal with which those of my brother officers of the Navy, who, from time to time, have been engaged with me upon it, have carried out my views with regard to the manner of conducting it.

Ever since Log books have been kept at sea, and preserved in old sea chests and garrets on shore, the materials for such a system of investigations as this is, have existed. But the labor of collecting from such records, the remarks on the wind and weather, and of collecting the experience of each one in relation thereto,

of classifying it, and arranging it side by side with the experience of all the rest, and of presenting the combined results in such a manner as to be obvious at a glance and available to all, appeared a Herculean task, which no one before had offered to undertake. Therefore since these charts are but a compilation of what has fallen under the observation of others, and therefore of what was already known to some person or another, it, in one sense, may be said that they have discovered nothing. Be that as it may, it is certain that they have brought to light before the public and made available to navigators generally, facts, circumstances, and conditions which before were known only to a few.

In 1842, the first official move was made with regard to the subject. In that year, I called it to the notice of the late Commodore Wm. M. Crane, the Chief of the Bureau of Ordnance and Hydrography, himself an officer of the most exalted worth. He at once appreciated the importance of the undertaking, and entered, as he always did with regard to everything that was useful in his profession, or beneficial to the great interests of navigation, most heartily into the spirit of it.

The following circular letter was accordingly issued by him:

Bureau of Ordnance and Hydrography,

Washington City, 16*th December*, 1842.

Sir:—This Bureau is making arrangements for collecting, with the view of rendering accessible to navigators, all that valuable information relating to the navigation of distant seas, which is collected by our enterprising commanders of merchant vessels in their various pursuits; and much of it hitherto, for the want of some regular channel of communication, has been lost to the public at large.

To enable it to bring this undertaking to a useful issue, this Bureau relies much on the public spirit and intelligence of American owners and masters of ships. It takes this opportunity of inviting their co-operation, and of requesting the favor of you to communicate any information of a general character, that you may now or at any time possess, relating to the following subjects.

1. Discoveries of islands, rocks, shoals, and dangers, or obstructions of any kind to navigation.

2. Shifting bars and shoals, errors of charts, wrong or corrected latitude and longitude.

3. Direction, rise and fall of tides, time of high and low waters on full and change days at ports but little known. Any tidal phenomena, such as extraordinary rises, one ebb and flow in 24 hours, etc.

4. Discoveries of new anchorages or harbors, with sailing directions, together with information as to wood, water, and every thing of interest to the navigator.

5. Force and set of currents.

6. Variation of the compass.

7. Latitude and longitude of icebergs when out of their usual track.

8. Tracks of remarkable short passages.

9. Limits of the trade winds at particular seasons of the year.
10. Any information relating to commerce and navigation.

Respectfully, your obedient servant,

W. M. CRANE.

From some cause or other this call for information passed by unheeded. The only response to it was made nine years afterwards by Captain Potter. I quote it as a part of the history connected with the Wind and Current Charts. It is as follows:

William M. Crane, Esq.

Sir:—According to your request I note the following particulars. On my passage to Japan sea in March of 1848, passed over the position of Bishop's Rock of Hone's Chart; 20° 10′ North, 136° 50′ East. Does not exist. Saw Douglass Reef, which is dangerous; Lat. 20° 25′ North; Long. 136° 25′ East. Saw Loo Choo Islands, passed to westward of them; which is a good route for Straits of Corea. April 17th, passed Tsusima Island in Straits of Corea, leaving it on the starboard hand, which is the best passage in to the sea of Japan; the Straits of Matsmai being dangerous and difficult on account of strong currents; several ships having lost cables and anchors in this passage. Cruised in this sea until the 4th of August, when I went through Perouse Straits.

Winds in Japan sea variable, but mostly from S. to S. W. Ships bound through Perouse Straits must give the Island of Kefunkerz or Tee Shee, a good berth, as there is a reef off the N. W. end of the island not on the chart—distance 5 to 10 miles—on which the ship David Poddoik was totally lost in July, 1848.

September 10th,—ran through Boussole Strait. Found the Island of Marekan laid down 30 miles to westward of its true position; have been informed that the most of the Kurile Islands are laid down wrong.

This information is generally known to the whaling fleet, but perhaps may not be known to your department.

Respectfully, your obedient servant,

OLIVER POTTER,

At sea, *April 30th*, 1851. *Ship Mechanic, Newport, R. I.*

This attempt to collect materials for a set of charts having failed, I next went to the old Log books of the Navy, and obtained authority to construct from the materials afforded by them, a set of "Wind and Current Charts."

Upon examination it was found that many of the scold Logs were wanting, and the number on hand not large. But though slender the data and meagre the materials, it was determined that a beginning should be made. It was made, but the requisite data and means were wanting. It proved an uphill business, and so we balked.

I then brought the subject to the notice of the men of science of the country, with the view of procuring their countenance to the work; and, in papers read on the currents of the sea before the National Institute, and the Association of American Geologist and Naturalists, now the American Association, I explained the meagre

state of our information with regard to the currents of the sea, urged the value of what was locked up in the old sea chests of mariners, and pressed the importance to science, commerce, and navigation, of the information which navigators might give were they enlisted in a common plan of observation concerning the phenomena of the ocean.

These institutions expressed an interest in the matter, and resolved to second my efforts by appointing a committee to press the subject upon the attention of the Government. The Hon. Jno. Y. Mason, then Secretary of the Navy, heartily seconded the plan, and did as his successors have done, much towards its advancement and progress.

In the mean time I obtained the assistance of Lieut. Wm. B. Whiting, United States Navy, a most accomplished draftsman and hydrographer. He was ordered to report for duty at this office in 1845.

The labor was commenced anew; more Log-books had been procured from our men-of-war. It was now seen that we should obtain more and better materials than we had before: all the former work was therefore rubbed out, and we began anew.

But our men-of-war seldom went to England or the north of Europe, therefore nothing was to be done in that quarter. The direction in which they most cruised was South of the parallel of 40° North.

The beginning of 1848, found three sheets—those which correspond to Nos. 1, 2, and 3 of the present Track Charts, series A, North Atlantic—engraved and published.

They contained only the tracks of men-of-war, but though there were few of these, I was satisfied that the work, so far, enabled me to point out a shorter and a quicker, and a better route to Rio than the one usually pursued. This was a discovery, as far as the great body of navigators was concerned; and as such I announced it. The barque W. H. D. C. Wright, Jackson, of Baltimore, was the first to try this new route. She crossed the Line in Longitude 31° West, the 24th day out, (it has since been done in 18 days, the usual time before was 41 days,) and made the trip to Rio and back, in 75 days. A remarkable quick voyage it was, and a complete demonstration of the problem that I had so long endeavored to prove.

Navigators now appeared for the first time to comprehend clearly what it was I wanted them to do; they appreciated the importance of the undertaking, and came forward readily with offers of hearty, zealous and gratuitous co-operation.

In a short time a large fleet, without the promise or hope of reward, was found zealously co-operating with me, each one engaged in collecting, according to the same plan, materials for the work; more than a thousand navigators are now busied night and day in all parts of the world, in making observations and gratuitously collecting materials of great value to science, commerce and navigation; never before has there been such a corps of observers scattered over the world, yet laboring together and acting in concert, with regard to any system or subject of philosophical research.

This fact speaks volumes in favor of the intelligence and public spirit of American navigators, and as a sailor I mention it with proud satisfaction.

Being now fairly under way with new and more abundant materials, and having the assistance of such a large, able, and zealous corps of observers in collecting more, it was again found necessary to rub out and begin afresh with the charts.

The third trial was more successful. It has placed us where we are.

As, therefore, these charts, so far, are the results of the joint labors of American navy officers and ship-masters, and as each one who has contributed to them, may be supposed to feel more or less interest in the progress of the work, as well as in the results obtained, it is proper that for the satisfaction of those concerned, if for no other purpose, I should give an account somewhat in detail of the manner in which the work has been conducted, and of the results, step by step, as they have been obtained and announced to the public.

The manner in which the investigations for each set of charts have been conducted, is fully explained in another part of this paper; and this will be readily understood by a reference to the plates and diagrams which accompany this volume.

The results so far as they have appeared satisfactory and conclusive to my own mind, have for the most part already been made public; sometimes as official reports; sometimes in the shape of letters; sometimes in public lectures, or in scientific papers; and sometimes directly to mariners, as a notice in the newspapers.

I shall therefore recapitulate, as I go along, the substance of these announcements, occasionally presenting the results first announced, not as they have since been modified, but as they appeared at the time; so that those who have helped to raise the structure to its present proportions, may have an opportunity of contemplating the scaffolding also. They will thus be enabled to retrace the work, and to follow it in its progress, step by step, realizing as they advance how it is, that our views enlarge, and the horizon expands as we ascend from one fact to another, and rise higher and higher as fact is traced to effect, and effect back to cause.

The first log books that were used in the construction of these Charts, not being kept with the view of ever being so used, gave the winds generally, and especially when sailing free, as from the *quadrant* instead of from the point of the compass.

Thus vessels on the homeward track from Rio, after meeting the N. E. trades, generally recorded the winds as "Northward and Eastward." This induced me to suppose that the winds were from the N. E. *point* of the compass, instead of the N. E. quadrant, and to infer, after the brushes by which the course and direction are represented on the "Track" Charts were drawn, that these winds were for the most part fair winds for going to the Equator also.

So understanding the entries in the Log, I saw that it was practicable for a vessel under canvass to sail on a great circle from New York to Cape St. Roque in Brazil; I therefore recommended a more direct route than had hitherto been pursued, and it is this route, which, with the additional information and the modifications and exceptions which subsequent researches have enabled us to make with regard to it, has proved so short and successful.

Seeing this defect in the old Log books, a form was prepared expressly for those navigators who were volunteering to co-operate with me. In this form they are requested particularly, always to note the *point* of the compass from which the wind comes; and when it is variable, to note and enter, at the time, the point of the compass from which it may have most prevailed, during each of the "three parts" into which mariners are accustomed to divide the 24 hours. *When a navigator fails to do this, he returns to me a useless Log.*

*Influence of the Gulf Stream on the Trade of Charleston.**

Before the Gulf Stream was known to practical navigators, the course of trade between England and America was such as to make Charleston the half-way house between the mother country and the New England States, including Pennsylvania and New York among the latter.

At that time, the usual route of vessels bound to America, was to run down on the other side of the Atlantic towards the Cape de Verdes, and until they got the N. E. trades, and with them steer for America. This was the route taken by Columbus; this route brought them upon the coast of the Southern States, where their first landfall was generally made. Then steering to the northward, they drifted along with the Gulf Stream until they made the Capes of the Delaware, or other headlands to the North.

If now, as it often happened in the winter season, they were driven off the coast by snow storms and westerly gales—instead of running off into the Gulf Stream, as vessels now do, to thaw themselves, they stood back to Charleston, or the West Indies, where they would spend the winter, and wait until the spring before making another attempt to enter the northern ports.

It should be borne in mind that vessels then were not the sea boats or the sailers they now are. I have in my collection, the Log-book of a West India trader in 1740. Her average rate of sailing per log, was about two miles the hour. This Log was copied in the 3d edition of this work. It is instructive.

At that time, the instruments of navigation were rude, chronometers were unknown, and lunars were impracticable, and it was no uncommon thing for vessels in those days, when crossing the Atlantic, to be out of their reckoning 5°, 6°, and even 10°. And when it was announced that a vessel might know by consulting the water thermometer, when she crossed the eastern edge of the Gulf Stream, and again when she crossed the western edge, navigators likened the discovery to the drawing of blue and red streaks in the water, by which, when the mariner crossed them he might know his longitude.

The merchants of Providence, R. I., Dr. Franklin being in London, sent a petition to the Lords of the Treasury, asking that the Falmouth packets might run to Providence instead of to Boston; they maintained that though Boston and Falmouth were between Providence and London, yet that practically the two former were further apart, than the two latter, for it was shown in the memorial, that the average passage of the London traders to Providence, was fourteen days less than the average by the packet line from Falmouth to Boston.

Dr. Franklin, on being questioned as to this fact, consulted Captain Folger, an old New England Captain, who had been a whaler, and who informed the Doctor that the London traders to Providence were commanded for the most part by New England fishermen, who knew how to avoid the Gulf Stream, while the Falmouth packets were commanded by Englishmen who knew nothing about it.

These two drew a chart, which was published at the Tower, and the limits of the Gulf Stream, as laid down there by that Yankee whaler, have been preserved upon our charts till within a few years.

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*See proceedings of the American Association, at Charleston, in 1850—for a paper "On the influence arising from the discovery of the Gulf Stream on the commerce of Charleston."

It is yet within the recollection of most navigators, how the traders from the New England States to the West Indies used to find their way out, "by running down the latitude" as it was called; the practice was to steer South until the latitude of their port was reached, and then to steer due West until they made the land. Their track was, therefore, on the two legs, instead of along the hypothenuse of a triangle.

The cause of this practice was in the practical difficulty of finding longitude at sea; for the general use of chronometers on board ships is an innovation which the masters of that kind of craft had not learned, 20 years ago, to tolerate.

Well might thermometrical navigators, therefore, when the chart appeared from the Tower, giving the longitude of the inner and outer edge of the Gulf Stream, liken those two lines to blue and red streaks painted on the ocean to show mariners their longitude.

At the time that Dr. FRANKLIN made it known how navigators, simply by dipping a thermometer in the water, might know when they entered, and when they cleared the Gulf Stream, Charleston had more commerce than New York, and all the New England States put together.

This discovery* changed the route across the Atlantic, shortened the passage from sixty to thirty days coming this way, and, consequently, changed the course of trade also.

Instead of calling by Charleston as they came from England, vessels, after this, went direct to the port of their destination; instead of running down to Charleston to avoid a New England snow storm, they stood off for a few hours, until they reached the tepid waters of the Gulf Stream, in the genial warmth of which the crew recovered their frosted energies, and as soon as the gale abated, they were ready for another attempt to make their haven.

In this way stations were shifted; the northern ports became the half-way house, and Charleston an outside station.

This revolution in the course of trade commenced about 1795. It worked slowly at first, but in 1816–17, it received a fresh impulse from JEREMIAH THOMPSON, ISAAC WRIGHT, and others, who conceived the idea of establishing a line of packets between New York and Liverpool. This was at a period when the scales of commercial ascendancy were vibrating between New York, Boston, Philadelphia, and other places. The packet ships of the staid New York Quaker turned the balance. Though only of 300 or 400 tons burden, and sailing but once a month, they had their regular day of departure, and the merchants of Charleston, Philadelphia, etc., found it convenient to avail themselves of this regular and stated channel, for communicating with their agents in England, ordering goods, etc. Those packets went on increasing in numbers and size until now, at the present day, we have them measuring 2000 tons, sailing every day, and running between New York and every fifth-rate sea-port town in the United States, and to many foreign ports.

Thus an impulse was given to the prosperity of New York; one enterprise begat another, until that city

*Though it was Dr. Franklin and Captain Folger, who first turned the Gulf Stream to nautical account, the discovery that there was a Gulf Stream cannot be said to belong to either of them, for its existence was known to Anghiera, and to Sir Humphrey Gilbert, in the sixteenth century.

became the great commercial emporium and centre of exchange of the new world. All these results are traceable to the use of the water thermometer at sea.

Other causes, doubtless, have operated to take away from Charleston her relative commercial importance—but the primary cause was that discovery which removed Charleston from the way-side of commerce with Europe, and which placed her on the outskirts of the great commercial thoroughfares, and away from the commanding position which she had before occupied.

In consequence of the improvements since made in navigation, ship building, etc., a ship can now go from New York to England, and back, in less time, than, when Charleston was the half-way house, she could get to Charleston from London.

I therefore submit, whether this fact be not sufficient to turn the scales of commerce, and I claim the result as one that is due to the influence of the Gulf Stream upon the course of trade, and the use of the water-thermometer by mariners is the key to it all.

I have now in the process of construction at the National Observatory, a series of charts relating to the thermal state of the ocean, that when completed, will give us more information with regard to the temperature of that sea, than we now possess with regard to the temperature of any district on shore for one tenth-part of the extent.

I have quoted in the third edition of this work, but think it unnecessary to repeat it here, "*the first Log-book of the 'Celia,' on the voyage from Jamaica to Bristol, in Great Britain*, 1748." From it the mariner, the merchant, and the statesman, the political economist and the philosopher, may all draw instruction.

If this Log-book be a fair sample of the Log-books of that day, and there is no reason to suppose it otherwise, the wonder is, not that the philosopher in arranging the different avocations of mankind, should have been doubtful whether to class the mariner at sea with the living or the dead; but that men should have been found rash enough to become mariners at all, or merchants bold enough to make ventures abroad.

This voyage was performed without any other means of finding the way across the Atlantic, than such as are afforded by the Log and Line.

It was performed under circumstances which forcibly remind one of the buccaneers, the sea robbers, the obstructions to commerce, and dangers to navigation, with which the ocean swarmed in those days. Ships had then to sail in company, and beg convoy for protection. The speed of the fastest in the fleet was regulated by the dullest sailer of them all; and under such a state of things, naval architecture must needs be in a rude state. The enterprising merchant had no inducement to incur the expense of building a fast sailing ship, because her speed would be practically regulated by the snail's pace of the dullest ship, and the most indolent master in the convoy. The "Celia," we may infer from the air of exultation with which when going 4 knots, the entry is made in the Log: "ahead of all the fleet," was at least a fair sailer for her day: and the most that they got out of the "Celia" that voyage, was five knots.

The better to appreciate the advantages, which we of the present day enjoy, in consequence of so many of the obstructions and trammels which fettered commerce, having been stricken off from its various departments,

and in consequence of the advances which have been made since that day towards free trade, we have but to suppose a decree ordaining that our ships, sailors, implements, means, circumstances, and conditions of navigation and commerce, should suddenly be reversed and become such as they were in 1740. The ruin that would follow, would not only swamp merchants, but it would sit heavily upon governments and nations.

Currents of the Sea.

In studying the system of oceanic circulation, I have found it necessary to set out with the very obvious and simple principle, viz: that from whatever part of the ocean a current is found to run, to the same part a current of equal volume is obliged to return.

Upon this principle is based the whole system of currents and counter-currents of the air as well as of the water.*

It is not necessary to associate with oceanic currents the idea that they must of necessity, as on land, run from a higher to a lower level.

So far from this being the case, some currents of the sea actually run up-hill, while others run on a level.

The Gulf Stream is of the first class. In a paper read before the National Institute in 1844, I showed why the bottom of the Gulf Stream ought, theoretically, to be an inclined plane, running *upwards*. If the Gulf Stream be 200 fathoms deep in the Florida Pass,† and but 100 fathoms off Hatteras, it is evident that the bottom would be uplifted 100 fathoms within that distance; and therefore, while the bottom of the Gulf Stream runs up-hill, the top preserves the water-level, or nearly so; for its banks are of sea-water, and being in the ocean, are themselves on a water-level.

The currents which run from the Atlantic into the Mediterranean, and from the Indian ocean into the Red sea, are the reverse of this. Here the bottom of the current is probably a water-level, and the top an inclined plane, running *down-hill.*

Take the Red sea current as an illustration. That sea lies for the most part within a rainless and riverless district. It may be compared to a long and narrow trough.

Being in a rainless district, the evaporation from it is immense; none of the water thus taken up is returned to it either by rivers or by the rains.

It is about 1000 miles long; it lies nearly North and South, and extends from latitude 12° or 13° to the parallel of 30° North.

I am not able to state the daily rate of evaporation there;‡ but it may be safely assumed—and for the illustration I will assume it—at the rate of two-tenths (0. 2 in.) of an inch a day.

* Vide paper "on the Currents of the Atlantic ocean," proceedings of the American Association, Charleston, March, 1850.

† Soundings made by order of Commodore Warrington, on board the U. S. Ship Albany, Commander Charles T. Platt, U. S. N., a few weeks since, show it to be at least 500 fathoms deep in the Florida Pass.

‡ I learn from Johnston's beautiful Physical Atlas, that "from May to October, in the upper part of this sea, the water is two feet lower than in the other months;" and this he accounts for, by the wind which is said to prevail from the northward there, during this season of the year.

This is the hot season; it is the season when evaporation is going on most rapidly; and when we consider how dry, and how hot

Now, if we suppose the current which runs into that sea, to average from mouth to head 20 miles a day —and this is conjecture merely, but for the purpose of illustration also—it would take the water fifty days to reach the head of it. If it lose two tenths of an inch from its surface, by evaporation, it would appear, that by the time it reached the isthmus of Suez, it would have lost ten inches from its surface.

Thus the waters of the Red sea ought to be lower at the isthmus of Suez than they are at the straits of Babelmandeb. They ought to be lower from two causes, viz: evaporation and temperature—for the temperature of that sea is necessarily lower at Suez, in latitude 30°, than it is at Babelmandeb, in latitude 13°.

To make this quite clear; suppose the channel of the Red sea to have no water in it, and a wave ten feet high to enter the straits of Babelmandeb, and to flow up its channel at the rate of twenty miles a day, for fifty days, losing daily, by evaporation, two-tenths of an inch; it is easy to perceive that at the end of the fiftieth day this wave would not be so high, by ten inches, as it was the first day it commenced to flow.

The top of that sea, therefore, may be regarded as an inclined plane, made so by evaporation.

But the salt water, which has lost so much of its freshness by evaporation, becomes salter, and, therefore, heavier. The lighter water at the straits cannot balance the heavier water at the isthmus, and the colder and salter, and therefore, the heavier water must either run out as an under-current, or it must deposit its surplus salt in the shape of crystals, and thus gradually make the bottom of the Red sea a salt bed; or it must abstract all the salt from the ocean—and we know that neither the one process nor the other is going on. Hence we infer that there is from the Red sea an under or outer current, as from the Mediterranean through the straits of Gibraltar. Analysis would probably show the surface waters at the head, to be salter than those near the mouth of the Red sea, and it is hoped that some of my fellow laborers in the Red sea trade, will collect specimens of its waters, and afford us an opportunity of testing them.

And, to show why there should be an outer and under current from each of these two seas, let us suppose the case of a long trough, opening into a vat of oil, with a partition to keep the oil from running into the trough. Now, suppose the trough to be filled up with wine, on one side of the partition, to the level of the oil on the other.

The oil is introduced to represent the lighter water, as it enters either of these seas from the ocean, and the wine the same water, after it has lost some of its freshness by evaporation, and, therefore, has become salter and heavier.

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the winds are which blow upon this sea at this season of the year, we may suppose the daily evaporation to be immense;—no less, certainly, than half an inch, and probably twice that amount. We know that the waste from canals by evaporation in the summer time is an element, which the Engineer, when taking the capacity of his feeders into calculation, has to consider. With him it is an important element; how much more so must the waste by evaporation from this sea be, when we consider the physical conditions under which it is placed; its feeder, the Arabian sea, is a thousand miles from its head—its shores are burning sands—the evaporation is *ceaseless;* and none of the vapors which the scorching winds that blow over it, carry away, are returned to it again in the shape of rains.

The Red sea vapors are carried off and precipitated elsewhere. The depression in the level of its head waters in the summer time, therefore, it appears to me, is owing quite as much to the effect of evaporation as to the effect of the wind in blowing the waters back from it into the ocean. Analysis will probably show the surface water at the head, and the deep sea water at the mouth to be salter, and therefore heavier, than are the surface waters at the mouth of the Red sea.

Philosophers will acknowledge in grateful terms, the services of any traveller by the overland route to India, who will collect specimens of these waters, and afford Chemists an opportunity of testing them.

Now, suppose the partition to be raised, what would take place? Why, the oil would run in as an upper current overflowing the wine, and the wine would run out as an under current.

The rivers which discharge in the Mediterranean, are not sufficient to supply the waste of evaporation—and it is by a process similar to this, that the salt which is carried in from the ocean is returned to it again; were it not so, the bed of that sea would be a mass of solid salt.

The equilibrium of the seas is preserved, beyond a doubt, by a system of compensation as exquisitely adjusted as are those by which the "music of the spheres" is maintained.

I have also, on a former occasion, pointed out the fact, that, inasmuch as the Gulf Stream is a bed of warm water, lying between banks of cold water—that as warm water is lighter than cold—therefore, the surface of the Gulf Stream ought, theoretically, to be in the shape of a double inclined plane, like the roof of a house, down which we may expect to find a shallow surface or roof-current, running from the middle, towards either edge of the stream.

The fact that this roof-current does exist, has been fully established: A person, who has been engaged on the Coast Survey with observations on the Gulf Stream, informed me that when he tried the current in a boat, he found it sometimes East and sometimes West, but scarcely ever in the true direction; whereas the vessel, which drew more water, showed it to be constantly in a northeasterly direction.

My object at present is, not to account for the currents of the Atlantic, but merely to mention the fact, to call attention to it: that, though there be well-known currents which bring immense volumes of water *into* the Atlantic, we know of none which carry it out again, and which, according to the principle with which I set out, ought to be found running back from that ocean.

The La Plata and the Amazon, the Mississippi and St. Lawrence, with many other rivers, and several large oceanic currents, run into this very small ocean, and it is not probable that all these waters are taken up from it again by evaporation; "yet the sea is not full." Where does the surplus go? The ice-bearing current, from Davis' Straits, which is counter to the Gulf Stream, moves an immense volume of water down towards the equator.

The ice-bearing current which runs from the Antarctic regions, and passes near Cape Horn into the Atlantic, and the Lagullas current, which sweeps into it around the Cape of Good Hope, both move immense volumes of water also, and bear it along also towards the equatorial regions of the Atlantic.

This water must get out again, or the Atlantic would be constantly rising.

A part of the Gulf Stream runs around North Cape into the Arctic ocean. The thermal charts of the Atlantic ocean now in process of construction, prove this, as also do the admirable charts of Prof. Dove, of Berlin.

This current around North Cape probably performs the circuit of the Arctic ocean, and returns to the Atlantic with increased volume.

There are the rivers of Northern Europe, and all the great rivers of Asia and America, that empty into the Frozen ocean; also the current from the Pacific ocean, through Behring's Straits. All these sources of supply

serve, in my opinion, to swell the current down from Baffin's Bay through Davis' Straits into the Atlantic. How does all this water escape from this ocean again, is the question?

That there is an open water communication, sometimes at least, from Behring's Straits to Baffin's Bay, has been all but proved by the results of investigations undertaken about two years ago, at the National Observatory, with regard to the habits, migrations, etc., of the whale.

These researches were commenced at this office by Lieutenant Herndon, and they were conducted in such a manner, as to show by a glance at the chart, in what parts of the ocean, and in what months of the year, whales had and had not been seen.

These investigations soon led to the discovery, that to the right whale, the equator is as a wall of fire—that that animal is never found near it, seldom or never within a thousand miles of it, on either side.

This fact induced me to inquire of the whalemen, whether the right whale of the northern and the right whale of the southern hemispheres was the same animal.

The answer was "No." The right whale of the latter region, as described by these men, is a small pale animal, the largest scarcely yielding more than fifty barrels of oil. Whereas, that of the northern region is a large dark animal, yielding frequently to the single fish upwards of two hundred barrels.

About this time the whale-ship Superior returned from a voyage through Behring's Straits, where she also found the right whale of the North Pacific.

This fact induced the further inquiry, as to whether the right whale of Behring's Straits, and the right whale of Davis' Straits were the same animal. For since the fact had been established that the right whale of the North Pacific could not cross the equator, and therefore could not get into the North Atlantic by either of the Capes, a reply in the affirmative to this inquiry would be another link in the chain of circumstantial evidence, going to prove the existence of a so-called Northwest Passage.

The answer from the whalemen in this instance, was, in effect; "we have not had an opportunity of comparing the two animals, except after long intervals, but, so far as we can judge, they are the same fish." So far as other facts go, it would appear probable that there is, at times, at least an open water-communication between the two straits; for the instincts of the whale, one might suppose, would prevent him from sounding under icebergs, neither could he pass under barriers of great depth or breadth. Seeing that water runs through Behring's Straits from the Pacific, as well as around the Capes, into the Atlantic, where, therefore, is the escape-current from the Atlantic?

The Trade Winds, I am prepared to show, are the great evaporating winds. They are the winds, which, returning from the polar regions, deprived of all the moisture which the hyperborean dew-point can compress from them, first come in contact with the surface of the earth, (and consequently with an evaporating surface,) where they are first felt as trades, and where, therefore, they are dry winds.

Now could the vapor taken up by these winds so increase the saltness of this sea in the trade wind region, as to make the water there though warmer, yet specifically heavier than that below, and also than that within the regions of the variable winds and of "constant precipitation?" If so, might we not have the anomaly of

a warm under current in the South Atlantic ocean, for that almost seems to be the only place of escape for a counter current from the Atlantic?*

Lieut. WALSH, of the schooner "*Taney*," and Lieut. S. P. LEE, of the brig "*Dolphin*," who were sent out by the Government, to make certain observations in connection with these researches concerning the winds and currents of the ocean, were at my request instructed, among other things, to examine for such a current.

On the General Circulation of the Atmosphere.†

Several years ago, I commenced to gather from old sea journals, such information as they might be found to contain, relative to the winds and currents of the sea, and to embody the information so obtained on a series of charts, in such a manner as to show by pictures, the prevailing direction of the winds and currents for every month, and in every part of the ocean. Indeed, the plan of the undertaking was to address the eye, to collect the experience of every navigator, and to present the combined results of the whole in such a manner, that each one might, with a glance, have the benefit of the experience of all who had preceded him in any of the frequented parts of the ocean.

This enterprize has been seconded both by the government and individuals. American ship masters generally have come into it with great zeal. They make the observations required on every voyage, and send them to me at Washington. There are some thousand or more ships voluntarily co-operating with me: and as it

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* NOTE.

MAIL STEAMER GEORGIA,
Off Havana, March 31st, 1852.

DEAR SIR:—On the 26th March we crossed the (Gulf) Stream, and when in Lat. 34°55′ N. and Long. 74°08′ W., at 11 a. m. with a moderate S. W. breeze blowing, temperature of air in the shade 69°.5, I put the thermometer in a bucket of surface water; after 2 minutes immersion it stood at 74°.5. I then proceeded to the main deck, to a wash deck pump, which receives its water 6½ feet below the surface. Here I pumped 8 buckets of water, and in the 9th placed the thermometer, which after 2 minutes immersion stood steady at 79°. I went then to the hold, and opened a cock 16½ feet below the surface, and allowed it to run a full clear stream into the hold for 15 minutes. This I did that the cock and pipe might take the temperature of the water, and thus prevent the heat of the ship from affecting the water whose temperature I desired to take. After it had run 15 minutes I drew a wooden bucket full in which I placed the thermometer as before. After two minutes entire immersion it stood at 86°.5, thus showing clearly and conclusively a difference between the surface water, and that at the depth of 16½ feet, of 12°.

These results I can assure you are exact, as the observations were several times repeated without difference, and I am confident that the water whose temperature I tested was in no degree affected by the heat of the vessel, I so carefully guarded against it.

This is the only time that I have been in the strength of the Gulf Stream; but yesterday, the 30th, in Lat. 24° 10′, Long. 80° 11′ (which you will perceive by the chart, and which the observation itself proves, does not place us entirely within the influence of the Stream, but very near its edge) I took another set of temperatures.

The thermometer stood in the shade at 79°, surface water was 78°, and water from the depth of 16½ feet stood after a fair and deliberate trial at 79°.5. The water from the 6½ feet pump I did not try, as there was so much sea on, that there could be no certainty whether it came from the surface or 12 feet below. I have had no further opportunities for observations of this character, than these, but I hope that these, scanty as they are, may be gratifying to you.

Very truly yours,
[Signed] A. C. JACKSON, U. S. N.
Acting master Cal. Com.

M. F. MAURY, *Superintendent of the Observatory.*

† See paper read before the American Association for advancement of science, Charleston, S. C., March, 1850.

might be supposed, from such a number of active and intelligent observers, we are collecting materials of great value.

During the course of these investigations, many interesting facts have been developed, amounting, in some cases, to actual discoveries of great interest—such as a new route, which shortens the sailing distance to the equator, some fifteen or twenty per cent., and, of course, proportionately to all ports beyond;—the existence in the North Atlantic of a regular monsoon—and in the North Pacific near the West course, of a perpetnal south west trade wind, near the equator—a unique phenomenon; also, the existence, near the same place, of a system of monsoons.

My present purpose, however, it not to speak of these discoveries, but rather to treat of the insight which these investigations, undertaken on such a large scale, afford as to the general system of atmospherical circulation over the earth.

They teach us to regard the atmosphere as a vast machine, that is apparently tasked to its utmost; but as one that is always in order and never breaks down.

It is a sewer into which, with every breath, we cast vast quantities of dead animal matter. It is a laboratory, into which, when the light and heat enter, they act upon this dead matter, decompose it, and resolve it into gaseous substances, to be by the action again of certain imponderable agents, condensed into plants and trees.

If it were not for this condensation, the air would become tainted; it would send its impurities back into the lungs; and continually receiving back more dead matter in return, it would finally become unfit for the respiration of certain animals, and man would perish from the face of the earth.

We hunger: we take as food that which has been gathered from the vegetable kingdom, into the stomach; there we elaborate it into flesh and blood. After it has coursed through the system, and performed its office, it is again cast forth into the atmosphere, to be reconverted into more vegetables, to serve as food for other animals. Doubtless the animal and vegetable kingdoms are in exact counterpoise; the one destroying, the other rearranging and rendering fit for use again, this same dead matter. In Infinite Wisdom, the two kingdoms are so balanced that there is not an insect too much on one side, nor a green leaf to little on the other. The atmosphere affords that compensation by which the proper proportions of each are maintained.

These are only some of the operations that are carried on daily and hourly through the machinery of the atmosphere which we are breathing. How important and profitable, therefore, does the study of its laws become!

It is an engine which pumps our rivers up from the sea, and carries them through the clouds to their sources in the mountains. Air and water are the great agents of the sun in distributing his heat over the surface of the globe, cooling this climate and tempering that; and in this light, I propose to concider the winds and to allude to the currents of the sea.

Though the winds blow here from the four quarters, and sometimes with such violence as to fill the mind with emotions of terror, yet such winds, in comparison with the general system of atmospheric circulation, are but eddies to the main current. They have no more effect in deranging or disturbing that system of circula-

tion, than the shower which they bring with them has in disturbing the course of the Gulf Stream, and other great currents of the sea.

From the parallel of about 30° North and South, nearly to the equator, we have two zones of perpetual winds, viz: the zone of northeast trades on this side, and of southeast on that. They blow perpetually, and are as steady and as constant as the currents of the Mississippi river—always moving in the same direction.

As these two currents of air are constantly flowing from the poles towards the equator, we are safe in assuming that the air which they keep in motion must return by some channel to the place near the poles, whence it came in order to supply the trades. If this were not so, these winds would soon exhaust the polar regions of atmosphere, and pile it up about the equator, and then cease to blow for the want of air to make more wind of.

This return current, therefore, must be in the upper regions of the atmosphere, at least until it passes over those parallels between which the trade winds are always blowing on the surface. The return current must also move in the direction opposite to the direction of that wind which it is intended to supply. These direct and counter currents are also made to move in a sort of spiral or loxodromic curve, turning to the west as they go from the poles to the equator, and in the opposite direction as they move from the equator towards the poles.

This turning is caused by the rotation of the Earth on its axis.

The earth we know, moves from West to East. Now if we imagine a particle of atmosphere at the North pole, where it is at rest, to be put in motion in a straight line towards the equator, we can easily see how this particle of air, coming from the pole, where it did not partake of the diurnal motion of the Earth, would, in consequence of its *vis inertia*, find, as it travels South, the Earth slipping under it, as it were, and thus it would appear to be coming from the northeast and going towards the southwest: in other words, it would be a N. E. wind.

On the other hand, we can preceive how a like particle of atmosphere that starts from the equator, to take the place of the other at the pole, would, as it travels North, in consequence of its *vis inertia*, be going towards the East faster than the Earth. It would, therefore, appear to be blowing from the southwest, and going towards the northeast, and exactly in the opposite direction to the other. Writing South for North, the came takes place between the South pole and the equator.

Now this is the process which is actually going on in nature, and if we take the motions of these two particles as the type of the motion of all, we shall have an illustration of the great currents in the air, the equator being near one of the nodes, and there being two systems of currents—an upper and an under—between it and each pole.

Let us return now to our northern particle, and follow it in a round from the North pole to the equator and back again, supposing it, for the present, to turn back towards the pole after reaching the equator.

Setting off from the polar regions, this particle of air, for some reason, which does not appear to have been satisfactorily explained by philosophers, travels in the upper regions of the atmosphere, until it gets near the parallel of 30°. Here it meets, also in the clouds, the hypothetical particle that is going from the equator to take its place toward the pole.

About this parallel of 30°, then, these two particles meet, press against each other with the whole amount of their motive power, produce a calm and an accumulation of atmosphere sufficient to balance the pressure from the two winds North and South.

From under this bank of calms, two surface currents of wind are ejected: one towards the equator, as the northeast trades—the other towards the pole, as the southwest passage winds—supposing that we are now considering what takes place in the northern hemisphere only.

These winds come out at the lower surface of the calm region, and consequently the place of the air borne away in this manner must be supplied, we may infer, by downward currents from the superincumbent air of the calm region.

Like the case of a vessel of water which has two streams from opposite directions running in at the top and two of equal capacity discharging in opposite directions at the bottom—the motion of the water in the vessel would be downward: so is the motion of the air in this calm zone.

The barometer, in this calm region, is said by Humboldt and others to stand higher than it does either to the North or to the South of it; and this is another proof as to the banking up here of the atmosphere and pressure from its downward motion.

Following our imaginary particle of air from the North across this calm belt we now feel it moving on the surface of the Earth as the northeast trade wind, and as such it continues till it arrives near the equator, where it meets a like hypothetical particle, which has blown as the southeast trade wind.

Here, at this equatorial place of meeting, there is another conflict of winds, and another calm region, for a northeast and southeast wind cannot blow at the same time in the same place. The two particles have been put in motion by the same power; they meet with equal force, and, therefore, at their place of meeting, are stopped in their course. Here, therefore, there is also a calm belt.

Warmed by the heat of the Sun, and pressed on each side by the whole force of the northeast and southeast trades, these two hypothetical particles, taken as the type of the whole, ascend. This operation is the reverse of that which took place at the other meeting near the parallel of 30°.

This imaginary particle now returns to the upper regions of the atmosphere again, and travels there until it meets, near the calm belt of Cancer, its fellow particle from the North, where it descends as before, and continues to flow towards the pole as a surface wind from southwest.

Entering the polar regions obliquely, it is pressed upon by similar currents coming from every meridian; here our imaginary particle approaches the higher parallels more and more obliquely, until it, with all the rest, is whirled about the pole in a continued circular gale: finally reaching the vortex, it is carried upwards to the regions of atmosphere above, whence it commences again its circuit to the South as an upper current.

Now the course we have imagined an atom of air to take is this: (Plate II) an ascent at P, at the North pole; an efflux thence as an upper current, until it meets G, (also an upper current,) over the calms of Cancer. Here there is supposed to be a descent, as shown by the arrows along the wavy lines which envelope the circle. This upper current from the pole now becomes the N. E. trade wind B, on the surface, it rises up at the equator,

and returns thence—we will suppose for the present only—back towards the North pole, as G, until it reaches the calms of Cancer, where it descends and is felt on the surface as H, the S. W. passage wind; and so the circuit is completed for the northern hemisphere.

The Bible frequently makes allusions to the laws of nature, their operation and effects. But such allusions are often so wrapped in the folds of the peculiar and graceful drapery with which its language is occasionally clothed, that the meaning, though peeping out from its thin covering all the while, yet lies, in some sense, concealed, until the lights and revelations of science are thrown upon it; then it bursts out and strikes us with the more force and beauty.

As our knowledge of Nature and her laws has increased, so has our understanding of many passages in the Bible been improved.

The Bible called the Earth "the round world," yet for ages it was a most damnable heresy for Christian men to say, the world is round; and, finally, sailors circumnavigated the globe, proved the Bible to be right, and saved Christian men of science from the stake.

"Canst thou tell the sweet influences of the Pleiades?"

Astronomers of the present day, if they have not answered this question, have thrown so much light upon it as to show that, if ever it be answered by man, he must consult the science of astronomy.

It has been recently all but proved, that the Earth and Sun, with their splendid retinue of comets, satellites and planets, are all in motion around some point or centre of attraction inconceivably remote, and that that point is in the direction of the star Alcyon, one of the Pleiades! Who but the astronomer, then, could tell their "sweet influences?"

And as for the general system of atmospherical circulation, which I have been so long endeavoring to describe, the Bible tells it all in a single sentence: "The wind goeth towards the South and turneth about unto the North; it whirleth about continually, and the wind returneth again according to his circuits." Ecc. i, 6.

A like operation takes place in the southern hemisphere. We now see the general course of the "wind in his circuits," as we see the general course of the water in a river. There be many abrading surfaces, irregularities, etc., which produce a thousand eddies to the main stream, yet, nevertheless, the general direction of the whole is not disturbed nor affected by those counter currents; so with the atmosphere and the variable winds which we find here in this latitude.

We see, also, that there must be about the habitable parts of the earth *at least* three zones or nodes, in which calms and light airs are the prevalent condition of the air. One of these zones is near the equator, where the northeast and southeast trade winds meet, and form what is called the belt of equatorial calms.

The other zones lie between those parallels where the "wind that goeth towards the South" meets that which "turneth about unto the North." They are the Calms of Cancer and of Capricorn. (See Plate II.)

About each pole we have, or, according to the views I have been endeavoring to make plain, we ought to have, a perpetual whirl of the wind in the ascending nodes there. I have endeavored to represent them by the direction of the curved arrows at the poles, P and P', (Plate II.) Here then are two more nodes: five in all.

The wind approaches the North pole by a series of spirals from the southwest. If we draw a circle about the North pole, on a common terrestrial globe, and intersect it by spirals to represent the direction of the wind, we shall see that the wind enters all parts of this circle from the southwest; and consequently that a whirl ought to be created thereby, in which the ascending column of air revolves from right to left, or *against* the hands of a watch.

At the South pole the winds come from the northwest, and consequently there they revolve about it *with* the hands of a watch.

That this should be so, will be obvious to any one who will look at the arrows on the polar sides of the calms of Cancer and Capricorn, Plate II. These arrows are intended to represent the prevailing direction of the wind at the surface of the earth, on the polar side of these calms.

It is a singular coincidence between these two facts thus deduced and other facts which have been observed, and which have been set forth by REDFIELD, REID, PIDDINGTON, and others, viz: that all rotary storms in the northern hemisphere revolve as do the whirlwinds about the North pole, viz: from right to left, and that all circular gales in the southern hemisphere revolve in the opposite direction, as does the whirl about the South pole.

How can there be any connection between the rotary motion of the wind about the pole and the rotary motion of it in a gale caused here by local agents?

So far, we see how the atmosphere moves; but the atmosphere, like every other department in the economy of nature, has is offices to perform; and they are many. I have already alluded to some of them. But I only propose at this time to consider some of the meteorological agencies which, in the grand design of creation, have probably been assigned to this wonderful machine.

To distribute moisture over the surface of the earth, and to temper the climate of different latitudes, it would seem, are two great offices assigned by their Creator to the ocean and the air.

When the northeast and southeast trades meet and produce the equatorial calms of the Atlantic, the air by this time is heavily laden with moisture—for, in each hemisphere it has travelled obliquely over a large space of the ocean. The two winds meet here with opposing forces so nicely balanced that they neutralize each other, and a calm is the consequence; and, as one is pressing from the North and the other from the South, upon the belt of the atmosphere over this calm region, and each with the whole amount of force that sets it in motion, we ought to have in this calm region an upward motion of the atmosphere, the motive power of which is the sum of these two forces. Now, if we had barometrical determinations accurately made in the region of these calms, we should probably obtain an expression, in horse power, if you please, of the whole amount of force exerted by the Sun in keeping up this system of atmospherical circulation—for it is the heat of the Sun, it is thought, which causes the winds to blow and the waters to flow; at least, it is supposed to be the chief source of their motive power.

The air of the equatorial calms being charged with moisture, and thus pressed upon by the trade winds North and South, has no room for escape but in the upward direction. It expands as it ascends and becomes

cooler: a portion of its vapor is thus condensed, and comes down in the shape of rain. Therefore it is, that under these calms we have a region of constant precipitation.

Old sailors tell us of such dead calms of long continuance here, of such heavy and constant rains, that they have scooped up fresh water from the surface of the sea.

The conditions to which this air is exposed here under the equator, are probably not such as to cause it to precipitate all the moisture that it has taken up in its long sweep across the waters.

Let us see what becomes of the rest—for nature, in her economy, permits nothing to be taken away from the earth which is not to be restored to it again in some form, and at some time or other.

Consider the great rivers—the Amazon and the Mississippi for example—we see them day after day, and year after year, discharging an immense volume of water into the ocean.

"All the rivers run into the sea, yet the sea is not full." Ecc. i, 7.

Where do the waters so discharged go, and where do they come from?

They come from their sources, you will say. But whence are their sources supplied?—for, unless what the fountain sends forth be returned to it again, it will fail and be dry.

We see simply, in the waters that are discharged by these rivers, the amount by which the precipitation exceeds the evaporation throughout the whole extent of valley drained by them—and by precipitation I mean the total amount of water that falls from, or is deposited by the atmosphere whether as dew, rain, hail or snow.

The springs of these rivers are supplied from the rains of heaven, and these rains are formed of vapors which are taken up from the sea, that "it be not full," and carried up to the mountains through the air.

"Note the place whence the rivers come, thither they return again."

Behold now the waters of the Amazon, of the Mississippi, the St. Lawrence, and all the great rivers of America, Europe and Asia, lifted up by the atmosphere, and flowing in invisible streams back through the air, to their sources among the hills; and that through channels so regular, certain, and well defined, that the quantity thus conveyed one year with the other is nearly the same: for that is the quantity which we see running down to the ocean through these rivers; and the quantity discharged annually by each river is, as far as we can judge, nearly constant.

We now begin to see what a powerful machine is the atmosphere; and though it is apparently so capricious and wayward in its movements, here is evidence of order and arrangement which we must admit, and proof which we cannot deny, that it performs this mighty office with regularity and certainty, and is therefore as obedient to law as is the steam engine to the will of its builder.

It too is an engine. The South seas themselves, in all their vast extent, are the boiler for it, and the northern hemisphere is its condenser.

The proportion between the land and the water in the northern hemisphere, is very different from the proportion between them in the southern. In the northern hemisphere, the land and water are nearly equally divided. In the southern, there is several times more water than land. All the great rivers in the world are in the northern hemisphere, where there is less ocean to supply them. Whence then are their sources replenished?

Those of the Amazon are supplied with rains from the equatorial calms and trade winds of the Atlantic. That river runs E., its branches come from the North and South; it is always the rainy season on one side or the other of it; consequently it is a river without periodic stages of a very marked character. It is always near its high water mark. For one half of the year its northern tributaries are flooded, and its southern, for the other half. It discharges under the line, and as its tributaries come from both hemispheres, it cannot be said to belong exclusively to either. It is supplied with water from the Atlantic ocean.

Taking the Amazon, therefore, out of the count, the Rio de la Plata is the only great river of the southern hemisphere.

There is no large river in New Holland. The South Sea Islands give rise to none, nor is there one worth naming in South Africa that we know of.

The great rivers of North America and North Africa, and all the rivers of Europe and Asia, lie wholly within the northern hemisphere. How is it then, considering that the evaporating surface lies mainly in the southern hemisphere—how is it, I say, that we should have the evaporation to take place in one hemisphere and the condensation in the other? The total amount of rain which falls in the northern hemisphere is much greater, meteorologists tell us, than that which falls in the southern. The annual amount of rain in the North Temperate Zone is half as much again as that of the South Temperate.

How is it then, that this vapor gets from the southern into the northern hemisphere, and comes with such regularity, that our rivers never go dry, and our springs fail not? It is because of the beautiful operations and the exquisite *compensation* of this grand machine—the atmosphere. It is exquisitely and wonderfully counterpoised. Late in the fall, throughout the winter, and in early spring, the Sun is pouring his rays with the greatest intensity down upon the seas of the southern hemisphere; and this powerful engine which we are contemplating is pumping up the water there for our rivers with the greatest activity. At this time, the mean temperature of the entire southern hemisphere is said to be about 10° higher than the northern.

The heat which this heavy evaporation absorbs, becomes latent, and with the moisture is carried through the upper regions of the atmosphere, until it reaches our climates. Here the vapor is formed into clouds, condensed and precipitated. The heat which held this water in the state of vapor is set free, it becomes sensible heat, and it is that which contributes so much to temper our winter climate. It clouds up in winter, turns warm, and we say we are going to have falling weather. That is because the process of condensation has already commenced, though no rain or snow may have fallen; thus we feel this southern heat that has been bottled away in the clouds of southern summer, and set free in the process of condensation in our northern winter.

While evaporation is going on with most activity in the southern hemisphere, precipitation is taking place to the greatest extent here; the fall spell, the winter rains, and the "long season in May," are familiar terms of wet weather to us all. These are the seasons at which we look for high water, and expect our "inland seas" to be in good navigable order.

The vapor comes through the upper regions of the atmosphere, and is probably condensed here not many

days after it is taken up there. Suppose it to travel with the velocity of the trade winds, at the computed rate of twenty miles the hour; it will only take it about twenty days to reach us from the middle of the southern hemisphere.

We cannot ascend into the upper regions of the atmosphere to see what is going on there; but we have such a train of well established facts derived from observations here below, that reason mounting on them, boldly soars aloft, and bids us confidently to assert knowledge of what is going on there.

When we see and feel, as in the trade wind region we do see and feel day after day, the year around, the wind blowing as steadily from the poles towards the equator, as the Mississippi runs down to the Gulf, we are forced to the conclusion that as much air, precisely as much, as we see coming from towards the poles, and going towards the equator, has to go from the equator back towards the poles. If this were not so, there would be an exhaustion, and this wonderful engine that we are considering, would break down, for there would finally be a vacuum about the poles with a tremendous atmospherical accumulation about the equator.

Recurring to the illustration given just now, and considering both hemispheres, we shall see that the atmosphere, like the string of a musical instrument, has its nodes or points of rest. These nodes serve as escape valves to the winds. In the equatorial calms, both the N. E. and S. E. trades have run their course on the surface, they are going up to blow as upper currents, and therefore the motion of the air here in these calms, could it be seen and measured, would be upwards; and for the same reason, when the two upper currents meet in the region of the Tropics, the motion of the air is downward, for after passing this node, each upper current becomes a surface wind, and each is going whence the other came.*

Important operations are carried on, and purposes grand in the system of terrestrial economy are doubtless subserved by these atmospheric nodes.

This singular fact has been brought out by the investigations which we are conducting at the Observatory, with regard to the winds: Our investigations in the Atlantic, for we have not carried them much further, show us that the S. E. trade wind region is much larger than the N. E.—I speak of its extent over the Atlantic ocean only.

The S. E. trades are the fresher; they often push themselves up to 10° or 15° of North latitude; whereas the N. E. trade winds seldom get South of the equator.

Seeing that there is so much more room for evaporation in the southern than in the northern hemisphere, and that there is so much more precipitation on this than on the other side of the equator, we are led to one of two conjectures: first, that aqueous vapor in its invisible state can permeate the atmosphere; in other words, it can flow through the air in separate or independent currents of its own, like some of the gases. In this case, we must further conjecture the seat of some power unknown, which would always drive this vapor from the southern over into the northern hemisphere. We know of no such tendency in vapor, of no such permeability

* If this interchange of atmosphere did not take place between the two hemispheres, how would a proper mixture of the air be preserved. In the North there is much more land, and many more plants and animals to corrupt the air, than in the South, and unless the interchange did take place, there would be a reason to infer a difference as to atmospherical purity in the two hemispheres.

of atmosphere, and of no such force in nature, and in this age therefore men would scarcely receive such a conjecture, as one having plausibility enough to command their respect.

Abandoning this, therefore, we are led to another conjecture, which is, that the motion of the air in the general system of circulation is not exactly such as I have already described; but that the N. E. trade winds for instance, when they reach the equatorial calms, instead of turning back towards the north, as I have supposed, keep on towards the South, and the S. E. trade winds make the tour north. In this case, the course of the winds, as described by SOLOMON, would be, as represented by the arrows, along the wavy curves, (Plate II,) A, B, C, D, to the South Pole, thence up with the arrow P and around with the hands of a watch, and back as indicated by the arrows along E, F, G, and H. Of course, as the surface winds, H, and D, approach the poles, there must be a sloughing off, if I may be allowed the expression, of air from the surface winds, in consequence of their approaching the poles. For as they near the poles, the parallels become smaller and smaller, and the surface current must either extend much higher up, and blow with greater rapidity, as it approaches the poles, or else a part of it must be sloughed off above, and so turned back before reaching the poles. The latter is probably the case.

If this plate and description fairly represent the course of the winds, we shall see that the S. E. trade winds would enter the northern hemisphere, and bear into it all their moisture, except that which is precipitated in the region of equatorial calms.

The South sea, then, if this reasoning be good, supplies mainly the water for this engine, while the northern hemisphere condenses it; we should, therefore, have more rain in the northern hemisphere. The rivers tell us that we have—at least on land: the great water courses of the globe, and half the fresh water in the world, are found on our side of the equator. This fact, alone, is strongly corroborative of this hypothesis.

The rain guage tells us also the same story. The yearly average of rain in the North Temperate Zone is according to JOHNSTON, 37 inches. He gives but 26 in the South Temperate.

Moisture is never extracted from the air by subjecting it from a low to a higher temperature, but the reverse. Thus, all that air which comes loaded with moisture from the other hemisphere, and is borne into this, with the S. E. trade winds, travels in the upper regions of the atmosphere until it reaches the calms of Cancer—here it becomes the surface wind that prevails from the southward and westward. As it goes North it grows cooler, and the process of condensation commences.*

We may now liken it to the wet sponge, and the decrease of temperature to the band that squeezes that sponge. Finally reaching the cold latitudes, all the moisture that a dew point of zero, and even far below, can extract, is rung from it; and this air then commences "to return according to his circuits" as dry atmosphere. And here we can quote Solomon again: "The North wind driveth away rain." This is a meteorological fact of high authority and great importance in the study of the circulation of the atmosphere.

* The peculiar clouds of the trade winds are formed between the two currents of air. They are probably formed of vapor condensed from the upper current, and evaporated as it descends, by the lower and dry current from the poles. It is the same phenomenon up there, which is so often observed here below: when a cool and dry current of air meets a warm and wet one, an evolution of vapor or fog ensues.

This air that is returning from the North in the general channels of circulation, does not ordinarily come in contact with the surface of the water, but remains in the upper regions isolated from all sources of vapor, except the upper clouds, until it descends in the calms of Cancer, and commences to blow the trades, as at B, (Plate II.) Here it is as the dry sponge, taking up and evaporating fresh water from the sea with great avidity. This supposition is strengthened by the circumstance that the saltest part of the ocean is near the calm belts of Cancer and Capricorn. By the time these winds reach the equatorial calms they are saturated with moisture; thus loaded, they return to refresh the earth with rain, to cover the hills with snow, and to supply the fountains of our great rivers with water.

By reasoning in this manner, we are led to the conclusion that our rivers are supplied with their waters, principally from the trade wind regions—the northern rivers from the southern trades, and the southern rivers from the northern trade winds.

Taking for our guide such faint glimmerings of light as we can catch from nature, and supposing these views to be correct, then the saltest portion of the sea should be in the trade wind regions, where the water for all the rivers is evaporated—and there the saltest portions are found.

Dr. Ruschenberger, of the Navy, on his late voyage to India, was kind enough to conduct a series of observations on the specific gravity of sea water.

In about the parallel of 17° N. and S. towards the Polar borders of the trade wind regions—he found the heaviest water. Though so warm, the water here was heavier than the cold water to the South of the Cape of Good Hope.

In summing up the evidence in favor of this view of the general system of atmospherical circulation, it remains to be shown how it is, if the view be correct, there should be smaller rivers or less rains in the southern hemisphere.

The winds that are to blow as the N. E. trade winds, returning from the Polar regions where the moisture has been compressed out of them, remain, as we have seen, dry winds until they cross the calm zone of Cancer, and are felt on the surface as the N. E. trades. About two-thirds of them only can there blow over the ocean, the rest blow over the land, over Asia, Africa, and North America, where there is but comparitively a small portion of evaporating surface exposed to their action.

The zone of the N. E. trades extends, on an average, from about 29° North to 7° North. Now if we examine the globe, to see how much of this zone is land, and how much water, we shall find, commencing with China and coming over Asia, the broad part of Africa, and so on, across the continent of America to the Pacific, land enough to fill up as nearly as may be, just one-third of it. This land if thrown into one body between these parallels, would make a belt equal to 120° of longitude.

Upon this supposition, then, two-thirds only of the N. E. trade winds are fully charged with moisture, and only two-thirds of the amount of rain that falls in the northern hemisphere falls in the southern.

This estimate as to the quantity of rain in the two hemispheres, is one which is not capable of verification by any more than the rudest approximations, for the greater extent of S. E. trades on one side, and of high mountains on the other, must each of necessity, and independent of other agents, have its effects.

These calm and trade wind regions or belts, move up and down the earth, annually in latitude nearly a thousand miles. In July and August, the zone of equatorial calms is found between 7° N. and 12° N.; sometimes higher; in March and April, between latitude 5° S. and 2° N.

With this fact, these points of view, and the Trade Wind Chart before us, it is easy to perceive why it is that we have a rainy season in Oregon, a rainy and dry season in California, another at Panama, two at Bogota, none in Peru, and one in Chile.

In Oregon it rains every month, but more in the winter months.

The winter there is the summer of the southern hemisphere, when this steam engine is working with the greatest pressure. The vapor that is taken up by the S. E. trades, is borne along over the region of N. E. trades to latitude 35° or 40° N., where it descends and appears on the surface with the S. W. winds of those latitudes. Driving upon the highlands of the continent, this vapor is condensed and precipitated during this part of the year, almost in constant showers.

In the winter, the calm belt of Cancer approaches the equator. This whole system of zones, viz: trades, calms and westerly winds, follow the Sun; and they of our hemisphere are nearest the equator in the winter and spring months than at any other season.

The S. W. winds, backing down at this season to the South, reach as far down as the lower part of California. In winter and spring the land in California is cooler than the sea air, and is quite cold enough to extract moisture from it. But in summer and autumn the land is the warmer, and cannot condense the vapors of water held by the air. So the same cause which made it rain in Oregon, now makes it rain in California. As the Sun returns to the North, he brings the calm belt of Cancer and the N. E. trades along with him; and now at places where six months before, the S. W. winds were the prevailing winds, the N. E. trades are found to blow. This is the case in the latitude of California. The prevailing winds then, instead of going from a warmer to a cooler climate as before, are going the opposite way. Consequently, they cannot, if they have the moisture in them to make rains of, precipitate it under such circumstances.

Panama is in the region of equatorial calms. This belt of calms, as may be seen by the charts, travels during the year back and forth over about 17° of latitude, coming further North in the summer, where it tarries for several months, and then returns so as to reach its extreme southern latitude some time in March or April. Where these calms are, it is always raining, and the chart shows that they hang over the latitude of Panama, from June to November; consequently, from June to November is the rainy season at Panama. The rest of the year, that place is in the region of the N. E. trades, which, before they arrive there, have to cross the mountains of the isthmus, on the cool tops of which they deposite their moisture, and leave Panama rainless and pleasant, until the Sun returns North with the belt of equatorial calms after him. They then push the belt of N. E. trades farther to the North, occupy a part of the winter zone and refresh that part of the earth with summer rains.

This belt of calms moves over more than double of its breadth, and the entire motion from South to North is accomplished generally in two months, May and June.

Take the parallel of 4° N., as an illustration: during these two months, the entire belt of calms crosses this parallel, and then leaves it in the region of the S. E. trades. During these two months, it was pouring down rain on that parallel. After the calm belt passes it, the rains cease, and the people in that latitude have no more wet weather till the fall, when the belt of calms recrosses this parallel on its way to the South. By examining the "Trade Wind Chart," it may be seen what the latitudes are that have two rainy seasons, and that Bogota is within the bi-rainy latitudes.

The coast of Peru is within the region of perpetual S. E. trade winds. Though the Peruvian shores are on the verge of the great South sea boiler; yet it never rains there. The reason is plain, and the charts make it obvious.

The S. E. trade winds in the Atlantic ocean first strike the water on the coast of Africa. Traveling to the N. W., they blow obliquely across the ocean until they reach the coast of Brazil. By this time, they are heavily laden with vapor, which they continue to bear along across the continent, depositing it as they go, and supplying with it the sources of the Rio de la Plata and the southern tributaries of the Amazon.

Finally, they reach the snow-capped Andes, and here is wrung from them, the least particle of moisture that that very low temperature can extract.

Reaching the summit of the range, they now tumble down as cool and dry winds on the slopes beyond. Meeting with no evaporating surface, and with no temperature *colder* than that to which they were subjected on the mountain tops, they reach the ocean before they become charged with fresh vapor, and before, therefore, they have any which the Peruvian climate can extract. Thus we see how the top of the Andes becomes the reservoir from which are supplied the rivers of Chile and Peru.

We see, moreover, that the Andes and all other mountains which run North and South have a dry and a rainy side, and that the prevailing winds of the latitude determine which is the rainy and which the dry side.

Thus let us take the southern coast of Chile for illustration: in our summer time, when the sun comes North, and drags after him his belts of perpetual winds and calms, that part of the coast is left within the regions of the N. W. winds—the winds that are counter to the S. E. trades—which, cooled by the winter temperature of the highlands of Chile, deposite their moisture copiously. During the rest of the year, the most of Chile is in the regions of the S. E. trades, and the same causes which operate in California to prevent rain there, operate in Chile; only the dry season in one place is the rainy season of the other.

Hence we see that the weather side of all such mountains as the Andes is the wet side, and the lee side the dry.

We shall now be enabled to determine, if the views which I have been endeavoring to present be correct, what parts of the earth are subject to the greatest fall of rain. They should be on the slopes of those mountains which the trade winds first strike after having blown across the greatest tract of ocean. The more abrupt the elevation as the land rises from the ocean, the greater the amount of precipitation.

If, therefore, we commence at the parallel of about 30° N. in the Pacific, where the N. E. trade winds first strike that ocean, and trace them through their circuits till they first strike high mountains, we ought to find such a place of heavy rains.

Commencing at this parallel of 30°, therefore, in the North Pacific, and tracing thence the course of the N. E. trade winds, we shall find that they blow thence, and reach the region of equatorial calms near the Caroline Islands. Here they rise up; but instead of pursuing the same course in the upper stratum of winds through the southern hemisphere, they, in consequence of the rotation of the earth, are made to take a S. E. course. They keep in this upper stratum until they reach the calms of Capricorn, between the parallels of 30° and 40°; after which they become the prevailing N. W. winds of the southern hemisphere, which correspond to the S. W. of the northern. Continuing on to the S. E. they are now the surface winds; they are going from warmer to cooler latitudes; they become as the wet sponge, and are abruptly intercepted by the Andes of Patagonia, whose cold cummit compresses them, and with its low dew-point squeezes the water out of them. Captain King found the astonishing fall of water here of nearly 13 feet (151 inches) in 41 days; and Mr. Darwin reports that the sea water along this part of the South American coast is sometimes quite fresh.

We ought to expect a corresponding rainy region to be found to the North of Oregon; but there the mountains are not so high, the obstruction to the S. W. winds is not so abrupt, the highlands are farther from the coast, and the air which these winds carry in their circulation to that part of the coast, though it be as heavily charged with moisture as at Patagonia, has a greater extent of country over which to deposit its rain, and consequently the fall to the square inch will not be as great.*

In like manner we should be enabled to say in what part of the world the most equitable climates are to be found. They are to be found in the equatorial calms, where the N. E. and S. E. trades meet fresh from the ocean, and keep the temperature uniform under a canopy of perpetual clouds.

The mean annual fall of rain on the entire surface of the earth is estimated at about 5 feet.

To evaporate water enough annually from the ocean to cover the earth, on the average, 5 feet deep with rain; to transport it from one zone to another; and to precipitate it in the right places, at suitable times, and in the proportions due, is the office of the grand atmospherical machine. This water is evaporated principally from the Torrid Zone. Supposing it all to come thence, we shall have, encircling the earth, a belt of ocean 3,000 miles in breadth, from which this atmosphere evaporates a layer of water annually 16 feet in depth. And to hoist up as high as the clouds, and lower down again, all the water in a lake 16 feet deep, and 3,000 miles broad, and 24,000 long, is the yearly business of this invisible machinery. What a powerful engine is the atmosphere !†

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* I have since through the kindness of A. Holbrook, Esq., U. S. Attorney for Oregon, received the Oregon Spectator of February 13, 1851, containing the Rev. G. H. Atkinson's Meteorological Table, kept in Oregon City, during the month of January, 1851. The quantity of rain and snow for that month is 13.63 inches, or about one-third the average quantity that falls here during the year.

† Since this paper was read, " Vol. IX Transactions Bombay Geographical Society, from May, 1849, to August, 1850," has been published. From it I derive valuable information in relation to this, as well as many other subjects. In his Annual Report to the Society, Dr. Buist, the Secretary, states on the authority of Mr. Laidly, the evaporation at Calcutta to be "about 15 feet annually; that between the Cape and Calcutta averages in October and November nearly ¾ inch daily;—betwixt 10° and 20° in the Bay of Bengal it was found to exceed an inch daily—supposing this to be double the average throughout the year, we should," continues the Doctor, "have 18 feet of evaporation annually," p. c.v.

If, in considering the direct observations upon the daily rate of evaporation in India, it be remembered that the seasons there are divided into wet and dry;—that in the dry season evaporation in the Indian Ocean, because of its high temperature—and also of the high

We see light beginning to break upon us—for we now begin to perceive why it is that the proportions between the land and water were made as we find them in nature. If there had been more water and less land, we should have had more rain, and *vice versa;* and then climates would have been different from what they now are, and the inhabitants, neither animal nor vegetable, would have been as they are. And as they are, that wise Being, who, in his kind Providence, so watches over and regards the things of this world that he takes knowledge of the sparrow's fall, and numbers the very hairs of our head, doubtless designed them to be.

In some parts of the earth the precipitation is greater than the evaporation; thus, the amount of water borne down by every river that runs into the sea may be considered as the excess of the precipitation over the evaporation that takes place in the valley drained by that river.

In other parts of the earth the evaporation and precipitation are exactly equal, as in those inland basins such as that in which the city of Mexico, Lake Titicaca, the Caspian Sea, etc., etc., are situated; which basins have no ocean drainage.

If more rain fell in the valley of the Caspian than is evaporated from it, that sea would finally get full and overflow the whole of that great basin. If less fell than is evaporated from it again, then that sea, in the course of time, would dry up, and plants and animals would all perish there for the want of water.

In the sheets of water which we find distributed over that and every other inhabitable inland basin, we see reservoirs or evaporating surfaces just sufficient for the supply of that degree of moisture which is best adapted to the well being of the plants and animals that people such basins.

In other parts of the Earth still, we find places, as the Desert of Sahara, in which neither evaporation nor precipitation takes place, and in which we find neither plant nor animal.

In contemplating the system of terrestrial adaptations, these researches have taught me to regard the great deserts of the Earth, as the Astronomer does the counterpoises to his telescope—though they be mere dead weights, they are, nevertheless, necessary to make the balance complete, the adjustments of this machine perfect. These counterpoises give ease to the motions, stability to the performance, and accuracy to the workings of the instrument. They are *compensations.*

Whenever I turn to contemplate the works of nature, I am struck with the admirable system of compensation, with the beauty and nicety with which every department is poised by the others; things and principles are meted out in directions the most opposite, but in proportions so exactly balanced and nicely adjusted, that results the most harmonious are produced.

It is by the action of opposite and compensating forces that the Earth is kept in its orbit, and the stars are held suspended in the azure vaults of Heaven; and these forces are so exquisitely adjusted, that at the end

temperature and dry state of the wind—probably goes on more rapidly there than anywhere else in the world—If, moreover, we remember that the regular trade wind regions proper, are for the most part rainless regions at sea; that evaporation is going on from them all the year round, we shall have reason to consider the estimate of 16 feet annually for the trade wind surface of the ocean not too high. What a powerful engine, therefore, may not the atmosphere be considered!

of a thousand years, the Earth, the Sun and Moon, and every star is found to return to its proper place at the proper moment.

Nay, philosophers tell us, when the little snow-drop, which in our garden walks we may now see raising its beautiful head to remind us that spring is at hand, was created, that the whole mass of the Earth from pole to pole, and from circumference to centre, must have been taken into account and weighed, in order that the proper degree of strength might be given to the fibres even of this little plant.

Botanists tell us that the constitution of this plant is such as to require that at a certain stage of its growth, the stalk should bend, and the flower should bow its head, that an operation may take place, which is necessary, in order that the herb should produce seed after its kind; and that after this its vegetable health requires that it should lift its head again and stand erect. Now, if the mass of the Earth had been greater or less, the force of gravity would have been different; in that case the strength of fibre in the snow-drop, as it is, would have been too much or too little; the plant could not bow or raise its head at the right time; fecundation could not take place, and its family would have become extinct with the first individual that was planted, because its "seed" would not have been "in itself," and therefore it could not reproduce itself.

Now, if we see such perfect adaptation, such exquisite adjustment, in the case of one of the smallest flowers of the field, how much more may we not expect "compensation" in the atmosphere, upon the right adjustment and due performance of which depends not only the life of that plant, but the well being of every individual that is found in the entire vegetable and animal kingdoms of the world.

When the East winds blow for a little while, they bring us air saturated with moisture from the Gulf Stream, and we complain of the sultry, oppressive, heavy atmosphere; the invalid grows worse, and the well man feels ill, because when he takes this atmosphere into his lungs, it is already so charged with moisture, that it cannot take up and carry off that which encumbers his lungs, and which nature has caused to be deposited there, that this atmosphere may take up and carry off. At other times the air is dry and hot; he feels that it is conveying off matter from the lungs too fast, he realizes the idea that it is consuming him, and he calls it parching.

Therefore, in considering the general laws of atmospherical circulation, in order to get at the clue to them, I have felt myself constrained to set out with the assumption, that if the atmosphere had had a greater or less capacity for moisture, or if the proportion of land and water had been different—if the earth, air and water, had not been in exact counterpoise—the whole arrangement of the animal and vegetable kingdoms would have varied from its present state. But God chose to make those kingdoms what they are; for this purpose it was necessary, in his judgment, to establish the proportions between the land and water, and the desert, just as they are, and to make the capacity of the air to circulate heat and moisture just what it is, and to have it to do all its work in obedience to law, and in subservience to order. If the proportions of each were not adjusted according to the reciprocal capacities of all to perform the functions required by each, why should we be told that "He measured the waters in the hollow of his hand, and comprehended the dust in a measure, and weighed the mountains in scales, and the hills in the balance?" Why did he span the heavens, but that he

might mete out the atmosphere in exact proportion to all the rest, and impart to it those properties and powers which it was necessary for it to have, in order that it might perform all those offices and duties for which He designed it? I have not the time, and if I had the time I have not the heart so to abuse the patience of those who read, as I should do, by attempting to discuss, at this time, the currents of the ocean, and to tell of the beautiful discoveries to which our system of investigations has led us with regard to those great agents in the terrestrial economy.

Harmonious in their action, the air and sea are obedient to law, and subject to order in all their movements; when we consult them in the performance of their offices, they teach us lessons concerning the wonders of the deep, the mysteries of the sky, the greatness and the wisdom and goodness of the Creator. The investigations into the broad-spreading circle of phenomena connected with the winds of heaven and the waves of the sea, are second to none for the good which they do, and the profit which they give.

The Astronomer sees the hand of God in the sky; but the right minded mariner who looks aloft as he ponders over these things, hear His voice in every wave of the sea that "claps its hands," and feels His presence in every breeze that blows.

Red Fogs and Sea Dust.

Every seamen has seen or heard of the "Sirocco dust" of the Mediterranean, and of the "African dust," or "Red Fogs" of the Cape de Verds and the adjoining ocean.

Thomas Ewbank, esq., who administers the office of the United States Patent Office with so much ability, has kindly furnished me with a description of *storms* of "African dust," or "sand," as it is sometimes called, which he encountered during a passage from Richmond, Va., to Rio de Janeiro, in the winter of 1845–6. He says:

"We had rough and wet weather for a fortnight or more. The roughest start for Rio, the Captain (an old trader) had ever experienced. Few sights interested me more, on approaching and passing through the flying-fish latitudes, than those beautiful and interesting creatures—indeed none, except superb oceanic skies, some of which were so rich that I endeavored to preserve their features for an artist friend. I presume there was nothing in them, gorgeous as they were, which had not been often seen by seamen; but at one part of the voyage, they changed in color and character, and, at length, so decidedly, as to excite the admiration of both skipper and crew—so rich and transcendently glorious and enchanting they became. It was, I believe, the introduction of a new pigment, so to speak, on the solar pallet, that wrought this wonder; although I did not suspect this until some days had elapsed. The color which now overpowered and gave tone to the celestial landscapes was that of a *rich cream*. I could compare it to nothing else, while its tints varied from fawn to pale white. It first was observed on the 10th of January, and disappeared on the 18th, leaving as suddenly as it came. Nothing of the kind occurred again, either on the outward or homeward voyage.

"January 10, 1846. Latitude 23° 33′ N., longitude 34° 37′ W. A swelling sea, but a glorious day.

Rich and mellow paintings over head—sketched one:—A narrow slate colored ribbon circumscribed the horizon, and upon it reposed a broad belt of vermilion, interspersed with soft dashes of India ink, shaded with umber. This glowing field merged insensibly above into a bright *cream* or *yellow*, (a new firmamental tint,) and this into a delicate pale green, which deepened upwards as it approached the summit of the dome; while over all, amber-stained masses floated diminishing in size, but deepening in tone, as they descended, and varying in figure everywhere.

"January 13. Latitude 16° 07′ N., longitude 31° 13′ W. The wind is strong from the east, and brings with it a RED IMPALPABLE POWDER, whose presence is visible on the windward side of the sails and rigging, and is thought to have been collecting for the past two days. It is only by bringing the bur or loose fibres on the outside of a rope, between the eye and the sun, that its presence and color are made manifest. The Captain calls it *African sand*—says he has observed the like before. The moon this evening, as well as the sun during the day, obscured by mist—supposed to be, in some measure, caused by the atmosphere being surcharged with the dust.

"January 14. Latitude 13° 14′ N., longitude 29° 39′ W. Thermometer at sunrise 72°, at 2 P. M. 76°, at sunset 74°. Sun clouded most of the day. The vessel ploughs up flying-fish, which, as they wing their way, one can hardly believe they are not swallows. At, and after sunset, appeared panoramic paintings, which no human pencil could approximate, nor human pen portray half their beauties.

"Imagine the zenith of azure, diminishing in tone down one-third of the vault, and there blending into living emerald, which, as it descended, vanished through a *straw tint* into brilliant white at 25° above, and continued with increasing brightness, near to the horizon. The heaving waves at our feet, constituting the dark and bold foreground of the picture, had dwindled into rest, and a pale band of misty brown 5° or 6° in depth, ran, as usual, round the horizon, its upper and broken edge, of course, in strong relief.

"Upon it rested, in one line, two adjoining streaks or short strata, of unequal length, densely black, and shaded mellow with umber. Two smaller lay just above, between one of which and the longest below, the glowing orb peeped out. They did not open sufficiently to show the perfect ball. Portions of its upper and lower boundaries were hid. Three more small strata of a deep chocolate hue were gracefully arrayed above, in manner of an eye-brow.

"Behind, and stretching far above, was something like a fawn colored fan, half opened, whose leaves were marked with silver rays, proceeding from, and centering in, the orb. A similar fan reversed was unfolded immediately beneath, but assumed a darker shade from the misty belt over which it spread, and now the finest trait—some eight or nine cumuli, picturesquely shaped, and of the *purest cream color*, formed a broken arch over the whole. The crown of this wide curve reached high into the emerald field; its wings of smaller masses descended through the glistening cream and white nearly to the dark band at the base of all. The highest portions of it were of a lighter tinge than those below, so much so, that in the varying back grounds the whole appeared in equal relief.

"I never saw nor imagined a scene so purely chaste and captivating, and never expect to see the like again.

"As the Sun sunk, the scene changed into another about as rich and novel! The clouds gradually turned to chocolate, and the *ground work* to *cream*, which lightened in tone upwards.

"Again: the zenith next was purple, which merged below into crimson, this into pink, and this into a light and *dead yellow*, which touched the narrow band at the horizon—now between cinerous and slate. Clouds varying in figure and magnitude, floated over this gorgeous ground work, all of deep umber, and their lower sides showing edges of red, more or less vivid.

"January 15. Latitude 10° 27′ N., Longitude 29° W. At 11 A. M., the Sun again obscured by a dark brown cloud of moderate size, beneath which a drab curtain stretches out, bordered with a wide cinerous hem below. From the concealed orb, white and *cream* tinted streams descend, producing a soft and singular contrast with the bright blue and green grounds above, with their light floating masses.

"In the afternoon another rich *ground work* of *cream* appeared, and upon it a numerous flock of chocolate fleeces, all edged with white and silver—a glorious picture. The day's drop-scene was almost as ravishing as that of yesterday, exhibiting much the same colors but differently disposed. A few particulars may give artists an idea of its character. The zenith blue, vanishing into greenish white, and thence into vivid white at about half-way down the vault, then a light *cream tint* commenced and continued *increasing in depth of tone* to the ribbon of slate at the horizon. Words are wanting to describe the richness of this cream below, its delicacy above, and purity throughout. The Sun was about 8° above the horizon, glowing as yesterday like an eye of molten gold between eyelids of densest jet.

"Six or seven degrees above him lay a dark brown fleece not less than 20° in length and 4° in depth, and but for some patches resembling dark tortoise shell, might be called a raven black. In front of this, shot up from the orb a fan of rays, and a similar one opened below him. Each did not exceed a sextant or sixth part of a circle. Their effect, relieved and modified as they were, by the different colored media, was of course, indescribable. Then, on either hand, and all above, were seen single clouds of varying forms and sizes—all of a rich chocolate hue. Their under sides being darkest, and edged with silver. Those lowest were deeper toned than those above. Their longer axes were inclined to the departing luminary, and moved after him, as if hastening to bid him good night.

"I thought these cream colored scenes might be named *Quaker skies*, for here the heavens in their loveliest costume, not only sanction, but adopt the very hues that pretty sisters of the sect prefer. Can George Fox, Wm. Penn, or other voyaging patriarchs of the Friends, while on missions over seas, have received their canonical colors immediately from above? Caught the idea and inspiration literally from the clouds?

"January 16. Latitude 7° 44′ N., Longitude 28° 31′ W. The *red dust* obviously *accumulating;* one of the foresails—an old one—looks as if it had received a coat of light brick colored paint, so much and evenly has the dust collected on it. We are opposite Seni-Gambia and Soudan, which border on the great desert, whence the Captain thinks the shower comes. He sent a man aloft to collect specimens for me, but after several ineffectual trials, I sent up a sheet of foolscap paper, which he rubbed over the sail, and sent it down coated over with a light reddish or pale-brick colored tint. The particles are so minute, and adhere so firmly to the villous nap, that no other way occurred to me to obtain them.

"Most of this colored sheet I destributed to friends—a small portion remaining in my journal is sent herewith: though a poor specimen, as from frequent handling the darkest parts have suffered much. A portion was sent to Professor Baily, at West Point, whose letter on the subject is now before me, dated March 6th, 1847. He says: 'I eagerly examined the atmospheric dust, for I confidently expected to find in it some of the siliceous infusoria which Ehrenberg describes. I can, however, detect nothing but irregular inorganic fragments, such as might come from minute volcanic dust. * * * * * * I believe if a more advantageous mode of collecting it had been adopted, more interesting results might have been obtained.'

"The ground of this evening's drop-scene—a light and dead yellow.

"January 17. Latitude 4° 57′ N., longitude 27° 43′ W. Air at sunrise 78°. Water 79°.5. Barometer 30.1. At noon, air 82°—at 8 P. M. 79°. Wind slackening—yesterday it wavered as if about to leave us. Sea smooth; air balmy, but damp. Towards evening the solar disc shone through the dense mist unaccompanied with a single ray."

"You will now, sir, be able to judge whether I am right or wrong in attributing the predominance of a cream color, in these celestial paintings, to the atmospheric sea of dust through which we were for several days sailing. If they appear where it prevails not, I am of course mistaken. At any rate, they appeared not till we entered, and after emerging from it, they were seen no more.

"Very respectfully, your obedient servant,

"THOS. EWBANK.

"LIEUT. MAURY, *National Observatory*."

This dust is also described by Ehrenberg and others, as of a brick red or cinnamon color, and it sometimes comes down in such quantities as to cover the sails and rigging, though the vessel may be hundreds of miles from the land. This dust had generally been supposed to come, as its name imports, from Africa.

Now, the generous mariner, who has had the heart to follow me around with "the wind in his circuits," will perceive that proof is yet wanting to establish it as a fact, that the N. E. and S. E. trades, after meeting and rising up in the equatorial calms, do cross over and take the tracks represented by C and G—Plate II.

Statements and reasons and arguments enough, have already been made and adduced, to make it highly probable, according to human reasoning, that such is the case; and though the theoretical deductions showing such to be the case, be never so good, positive proof that they are true, connot fail to be received with delight and satisfaction.

Were it possible to take a portion of this air, as it travels down the S. E. trades, representing the general course of atmospherical circulation, and to put a tally on this portion of air, by which we could always recognise it again, then we might hope, actually, to prove by evidence the most positive, the channels through which the air of the trade winds, after ascending at the equator, returns whence it came.

But the air is visible, and it is not easily perceived how either marks or tallies may be put upon it, that it may be traced in its paths through the clouds.

The skeptic, therefore, who is hard of belief that the general circulation is such as Plate II represents it to be, might consider himself safe in his unbelief, were he to declare his willingness to give it up the moment any one should put tallies on the wings of the wind, which would enable him to recognise that air again and those tallies, when found at other parts of the Earth's surface.

As difficult as this seems to be, it has actually been done. Ehrenberg, with his microscope, has established almost beyond a doubt, that the air which the S. E. trade winds bring to the equator, does rise up and pass over into the northern hemisphere.

The Sirocco or African dust which he has been observing so closely, has turned out to be tallies put upon the wind in another hemisphere; and this beautiful instrument of his enables us to detect the marks on these little tallies as plainly as though those marks had been written upon labels of wood and tied to the wings of the wind.

This dust, when subjected to microscopic examination, is found to consist of infusoria and organisms, whose *habitat* is not Africa, but South America, and in the S. E. trade wind region of South America. Prof. Ehrenberg has examined specimens of sea dust from the Cape de Verds and the regions thereabout, from Malta, Genoa, Lyons and the Tyrol, and he has found such a similarity among them, that would not have been more striking, had these specimens been all taken from the same pile.

South American forms he recognises in all of them; indeed they are the prevailing forms in every specimen he has examined.

Speaking of the dust which fell at Lyons, he says:—

"The fact is very especially remarkable in this fall of dust, that, notwithstanding its agreement with the Atlantic dust, which always showed dead and empty shells of organisms, the *eunotia amphyoxis has often been found with its green ovaries, and therefore capable of life.*"

The following are the general results and characteristics of the new sirocco dust as announced by him:

"1. The dust of the sirocco hurricane of the 17th of October, 1846, at Lyons, differs from the ordinary European and North African dust, but agrees entirely with the meteoric dust, which, since 1830, have been observed in the Atlantic ocean, near the Cape Verd Islands, and in the sirocco at Malta and Genoa. The specimens of all these kinds are as though they were taken from one and the same well mixed package of dust, although their highly various origin, and their innumerable multitude, are perfectly demonstrated.

"2. Besides, the direction of the wind, (which, according to the most recent and fortunate collections and conclusions of meteorologists—Dove—gives no indication of the source of the storm,) no釋 internel nor external evidence of the dust pronounces for its origin in Africa, but there are many forms there chiefly or wholly native to South America.

"3. Moreover, the Lyons dust cannot have arisen from the far interior of a continent, but only from a coast region, if it have generally a single origin, since it contains marine forms now living.

"4. The contents of this last sirocco dust are again not only like those of the very distant Cape V Islands, but even so very like what has fallen there for sixteen years, that the difference is far exceeded by agreement, and seems only to lie in the defect of our knowledge.

"5. As no uniform mixture, in such great numbers and so great intervals of time and space, can ar even though the investigations include so few occasions, neither from one limited place, where, indeed, vary moist seasons produce varying organisms, nor generally can it be an unimportant instantaneous upraising c local dust by whirlwind, it appears to belong necessarily, to a more constant series of relations, a const cloud-dust swimming in the atmosphere, and always receiving new contents, which a hurricane accidents meeting may scatter in any direction.

"6. In how far certain historical kinds of thick fog, (of course excepting that arising from peat fir coincide with the phenomenon, we cannot now decide; but it may be useful to point out the possibility of su a coincidence.

"7. The whole number of organic corpuscules detected in the nine kinds of dust yet known, and strikingly similar, amounts now to 19 species, namely:

Polygastrica,	57
Phytolitharia,	46
Polythalamia,	8
Particulæ plantarum molles,	7
Insectorum fragmenta,	1
	119

Of these, seventeen kinds,	8 Polythalamia,
" " "	7 Polygastrica,
" " "	2 Phytolitharia, (spongolithide

belong to the sea water; the remaining 102, with the exception, perhaps, of the few new kinds, are fr water forms.

"8. *Living forms have been brought in the more recent dust*, which, however, gives no scientific negat to the idea of an extensive sphere of life in the atmosphere. The cotemporaneous phytolitharia are ear forms—parts of not independent plants.

"9. The dust bears no trace of volcanic action. * * * * * *

"As in the Atlantic meteor-dust, so also in that of Lyons, the phytolitharia are very numerous, wh points to important conditions in the relations of the terrestrial surface, and the residue of vegetation, a *contradicts the formation of the substance in the atmosphere itself.*

"Comparing now the dust of this year (1847) from Tyrol, with the sirocco-dust of Malta, Genoa, a Lyons, previously described, and with the previously analysed meteor-dust of the Cape Verd Islands and Atlantic, we obtain the following highly remarkable relations:

"1. The color and the whole exterior in all characters, fineness, adhesiveness of parts, weight, are not in the dry Tyrol snow-dust as in the ordinary atmospheric dust of storms, but entirely and wholly similar to the sirocco and Atlantic dust.

"2. The organic contents which so highly characterise the Atlantic meteor-dust, and are similarly found in the sirocco-dust, are also found to agree in a very remarkable manner in the snow-dust.

"The analysis already published of the meteor-dust, fallen from 1830 to 1847, in the harmattan or trades, sirocco and fohn, show a great similarity in the intermingling of organic particles. Such an intermingling might be expected *a priori*, from every storm. But that in all, *similar* particles, and *great numbers of different particles, should similarly occur*, is very striking, and becomes yet more so when we consider *that for seventeen years, and in different times of the year, they remain so similar that even the predominating forms numerically, of one kind of dust, are also the predominating forms in all the rest.* That materials existing on the surface of the earth are so similarly carried about by storms is not supposable, if we give up the highly improbable notion that all the hitherto investigated meteors and storms had their origin at precisely the same limited locality of one and the same country. Wherever life is found, the seasons of the year or of rains alternate, and with them alternate, not only in theory, but according to my own frequent and direct experience, eiher the mode or the number of individual living forms. Considering the intermixture of marine animals, their constant similarity in number, and the always recurring predominance of the same forms, we see that no possibility remains of supposing that the meteor-dust, which the European sirocco and the German fohn wind bring, and which covers the Atlantic Ocean *only in the region of the trades*, even in the European winter, (January and February,) should *always originate directly from the West Indies.* Impossible as it is to conceive, of all the storms now compared from 1830 to 1847, as having a continuous genetic connection, it is equally impossible also to imagine the masses of dust transported by them, with such a degree of similarity, *not to have a genetic connection.*" * * * * * * * * * *

"The more," continues this eminent microscopist, "the more I have busied myself with these examinations of atmospheric dust, the more confident have I become that the subject is of great, manifold, and rapidly increasing import: that it conflicts with not a few important and weighty ideas, and draws out and establishes other new and important scientific notions. This is but the beginning of a future great department of knowledge. I hope that the following attempt to deduce results from the observations which I have collected with some trouble and very great care and circumspection, may not lead to giving too great prominence to what is unimportant, nor fail to place what is important in a light that may suggest farther and correct investigations,

"1. The phenomena here collected, under the name of trade-wind dust, have been hitherto known as dust-hurricanes, red dust-rain, red volcanic-ashes-rain, &c., &c.

"The name trade-wind dust was here first applied to the Atlantic meteor-dust. The connection of this with the trade wind, and not with the harmattan, was definitely pronounced in 1816 by Captain Tuckey; it was made known and published from the Prussian merchant-ship, Captain Wendt, in 1830; in 1837, by Bennet, and in 1839, by Captain Haywood. And Admiral Roussin separated the constant coast-cloud from the periodic harmattan, in 1817.

"5. In the microscopic analysis of this dust, fresh water and land forms are by far the most predomir
Only the following genera belong alone to the sea water:

Coscinodiscus, Grammatophora,
Diploneis, Biddulphia,
Goniothecium.

"And beside these, all the polythalamia and some spongoliths are sea formations. Sp. Clavus, censcep
Caput serpentis, obtusa robusta.

"Known African characteristic forms are not to be found. The great number of forms are found in var
parts of the world, even in Europe and Africa The following are American:

Arcella constricta, Eunotia quaternaria, Stauroneis dilatata,
Desmogonium guyanense, quinaria, Surirella peruana,
Eunotia Camelus, Gomphonema Vibrio, Synedra Entomon,
depressa, Himantidium Papilio, Fragmenta incerta,
Pileus, Zygodon,
Navicula undosa.

"There is in Africa no trade wind, and no surface of red dust which can supply the trade wind. ' sand of the Sahara is white and grey; the cloud-dust of the trades is cinnamon-colored. Since, accordin experience, an upper trade wind corresponds with the lower at the Peak of Tenneriffe, and since the lowe not an African wind, but different from the harmattan, it follows that only the upper wind can carry the du: Africa; and since probably it does not continue beyond, falling there, and becoming the lower trade wind precipitates the dust in that region. The fact that South American forms have been observed in the dust o trade winds gave rise originally to this theory, and is still favorable to it, and moreover the number of tl forms continually increases. The American dust, therefore, raised up in the region of equatorial calms ascending (South American) currents of air, and carried by the upward eastward trade winds to Africa, by vertical downward current, is returned to America through the lower western trades, unless it have been viously deposited in space.

"That this dust is coarsest near Africa may be explained by this direct sinking down in that regi while lower in the ocean it is more sifted out; but the dust of March 9, 1838, is not coarser than that from Jago in the Cape Verde Islands, in 1833. Thus, the place of falling down may always show the coarsest pa

"It is worthy of remark, that North America is seldom reached by the dust, and no ship in the Pac Ocean, whence we may conclude that the constant dust-cloud zone of the upper atmosphere truly belongs o the Atlantic northern trades; and over America, when it begins to appear in the South, wholly fails in the Noı as over the Sandwich Islands, and consequently cannot be brought down by fire-meteors and meteoric stones.

It is now proved that there is a perpetual upper current of air from South America to North Afri

*Vide "Passat-Staub und Blut-Regen, ein grosses organisches unsichtbares Wirken und Leben in der Atmosphäre.—Mehrere Vort von Dr. Christian Gottfried Ehrenberg: Berlin, 1849."

and that the volume of air in these upper currents which flows to the northward is nearly equal to the volume which flows to the southward with the N. E. trade winds, there can be no doubt.

The "rain-dust" has been observed most frequently to fall in spring and autumn; that is, the fall has occurred after the equinoxes, but at intervals from them varying from 30 to 60 days—more or less. To account for this sort of periodical occurrence of the falls of this dust, Ehrenberg thinks it "necessary to suppose *a dust cloud to be held constantly swimming in the atmosphere by continuous currents of air, and lying in the region of the trade winds, but suffering partial and periodical deviations.*"

Now, any one who will take the trouble to consult the "Trade Wind Charts" of the Atlantic Ocean, will see that at the time of the vernal equinox the equatorial calms are "raging" between the parallels of 4° N. and 5° S., and that consequently the places between these parallels are then in their rainy season.

The "rain-dust," therefore, it may be inferred, could not well be taken up between these two parallels at such a season. The earth is then flooded with rain, and there prevails a great calm; and as the air is saturated with moisture, and consequently as there is no—little or no—evaporation going on at such a time and place, it is difficult to imagine how any of the microscopic organisms of a locality so situated should be taken up in the atmosphere.

But if the examination of these charts be carried a little farther, it will be preceived that at the time of the vernal equinox, the valley of the lower Oronoco is then in its dry season,—everything is parched up with the drought, the pools are dry, and the marshes and plains arid wastes. All vegetation has ceased, the great serpents and reptiles have buried themselves for hibernation;* the hum of insect life is hushed; and the stillness of death reigns through the valley.

Under these circumstances, the light breeze, raising dust from lakes that are dried up, and lifting motes from savannahs that are parched up, will bear them away like clouds in the air.

This is the period of the year when the surface of the earth in this region, strewed with impalpable and feather-light remains of animal and vegetable organisms, is swept over by whirlwinds, gales, and tornadoes of terrific force; this is the period for the general atmospheric disturbances which have made characteristic the equinoxes. Do not these conditions appear sufficient to afford the "rain-dust" for the spring showers?

At this period of the autumnal equinox, another portion of the Amazonian basin is parched with drought, and liable to winds that fill the air with dust, and with the remains of dead animal and vegetable matter; these impalpable organisms which each rainy season calls into being, to perish the succeeding season of drought, are perhaps distended and made even lighter by the gases of decomposition which has been going on in the period of drought.

May not, therefore, the whirlwinds which accompany the vernal equinox sweep over the lifeless plains of the lower Oronoco, take up the "rain-dust" which descends in the Northern hemisphere in April and May; and may it not be the atmospherical disturbances which accompany the autumnal equinox that take up the microscopic organisms from the upper Oronoco and the great Amazonian basin for the showers of October?

* Humboldt.

If their be reason in this question, and plausibility in the answer it suggests, an affirmative reply w authorize us to infer that the "fatherland" of the "rain dust" is one place for the spring and another for autumn; and therefore it might be expected that the microscope would detect certain infusoria that are pec each to its own dust and locality.

These are the periods and these the conditions most favorable for raising the "sea-dust," and may not therefore refer to these conditions, and suggest that in them is to be found reason for the greater liab of the "rain dust" to fall in April and May, October and November, than at other times.

If one season of the year be most favorable to the taking up of the infusoria, another season may be n favorable for letting them down again. The charts indicate the former; the microscope shows the latter tc the case.

And may we not therefore regard the interval between the time most favorable for the ascent, and the ti in which the descent is most likely to occur, as a sort of general indication as to the length of the time requi for the transportation; and therefore as to the rate of motion of the atmosphere in its general channels of c culation?

These suggestions as to the taking up the dust in the valley of Oronoco, derive weight from the obser tions of the closest of observers:

The Baron von Humboldt, in his "Aspects of Nature," thus contrasts the wet and the dry seasons ther

"When under the vertical rays of the never-clouded Sun, the carbonized turfy covering falls into du "the indurated soil cracks asunder as if from the shock of an earthquake. If at such times two opposing cu "rents of air, whose conflict produces a rotary motion, comes in contact with the soil, the plain assumes a strang "and singular aspect. Like conical shaped clouds, the points of which descend to the earth, the sand ris "through the rarefied air on the electrically-charged centre of the whirling current, resembling the loud wat "spout, dreaded by the experienced mariner. The lowering sky sheds a dim, almost straw-colored, light o "the desolate plain. The horizon draws suddenly nearer, the steppe seems to contract, and with it the hea "of the wanderer. The hot, dusty particles which fill the air increase its suffocating heat, and the East win "blowing over the long-heated soil brings with it no refreshment, but rather a still more burning glow. Th "pools which the yellow, fading branches of the fan-palm had protected from evaporation, now gradually dis "appear. As in the icy North the animals become torpid with cold, so here, under the influence of the parch "ing drought, the crocodile and the boa become motionless and fall asleep, deeply buried in the dry mud. '

* * * * * * * * * * * * *

" * * * The distant palm bush, apparently raised by the influence of the contact of unequally "heated and therefore unequally dense strata of air, hovers above the ground, from which it is separated by "a narrow intervening margin. Half concealed by the dense clouds of dust, restless with the pain of thirst "and hunger, the horses and cattle roam around, the cattle lowing dismally, and the horses stretching out their "long necks and snuffing the wind, if haply a moister current may betray the neighborhood of a not wholly "dried-up pool. * * * * * * * * * * *

" * * * At length, after the long drought, the welcome season of the rain arrives; and then " how suddenly is the scene changed! * * * * * * * * *

" * * * Hardly has the surface of the Earth received the refreshing moisture, when the pre- " viously barren steppe begins to exhale sweet odors, and to clothe itself with killingias, the many panicules " of the paspulum, and a variety of grasses. The herbaceous mimosas, with renewed sensibility to the in- " fluence of light, unfold their drooping, slumbering leaves, to greet the rising Sun; and the early song of " birds, and the opening blossoms of the water plants, join to salute the morning." * * * *

The color of the "rain dust," when collected in parcels, and sent to Ehrenberg, is "brick-red," or "yellow ochre;"—when seen by Humboldt in the air, it was less deeply shaded, and is described *by him* as imparting a "straw color" to the atmosphere. In the search of spider lines for the diaphragm of my telescopes, I procured the finest and best threads from a cocoon of a mud-red color; but the threads of this cocoon as seen singly in the diaphragm, were of a golden color; there would seem, therefore, no difficulty in reconciling the difference between the colors of the rain dust, when viewed in little piles by the microscopist, and when seen attenuated and floating in the wind by the great traveler.

It appears, therefore, that we here have placed in our hands, a clue, which, attenuated and gossamer-like though it at first appears, is nevertheless palpable and strong enough to guide us along the "circuits of the wind" into "the chambers of the South."

The frequency of the fall of "rain dust" between the parallels of 17° and 25° N., and in the vicinity of the Cape Verd Islands, is remarked upon with emphasis by the author. It is worthy of remark; because in connection with the investigations at the Observatory, it is significant.

The latitudinal limits of the northern edge of the N. E. trade winds are variable. In the spring they are nearest to the equator, extending sometimes at this season not farther from the equator than the parallel of 15° N.

The breadth of the calms of Cancer is also variable; so also are their limits. The extreme vibration of this zone is between the parallels of 17° and 38° North, according to the season of the year.

According to the Charts, and the hypothesis suggested by them, this is the zone in which the upper currents of atmosphere that ascended in the equatorial calms, and flowed off to the northward and eastward, descend. This, therefore, is the zone in which the atmosphere that bears the "rain-dust" or "African sand," descends to the surface; and this, therefore, is the zone, it might be supposed, which would be the most liable to showers of this "dust." This is the zone in which the Cape Verd Islands are situated; they are in the direction which theory gives to the upper current of air from the Oronoco and Amazon with its "rain-dust," and they are in the region of the most frequent showers of "rain-dust," all of which are in striking conformity with this theory as to the circulation of the atmosphere.

It is true that in the present state of our information, we cannot tell why this "rain-dust" should not be gradually precipitated from this upper current, and descend into the stratum of trade winds, as it passes from the equator to higher northern latitudes, and as per Mr. Ewbank's journal, it sometimes does. Neither can we

tell why the vapor which the same winds carry along, should not, in like manner, be precipitated on the way; nor why we should have a thunder storm, a gale of wind, or the display of any other atmospherical phenomenon to-morrow, and not to-day—all that we can say is, that the conditions of to-day are not such as the phenomenon requires for its own development.

Therefore, though we cannot tell why the sea-dust should fall not always in the same place, we may nevertheless suppose that in passing the same parallels it does not always meet with the conditions—electrical and others—favorable to the descent—and that these conditions might occur now in this place, now in that. But that the fall does occur always in the same atmospherical vein or general direction, my investigations would suggest, and Ehrenberg's researches prove.

Judging by the fall of sea or rain-dust, we may suppose that the currents in the upper regions of the atmosphere are remarkable for their general regularity, for their general direction and sharpness of limits, so to speak.

We may imagine that certain electrical conditions are necessary to a shower of "sea-dust," as well as to a thunder storm, and that the interval between the time of the equinoxial disturbances in the atmosphere and the occurrence of these showers, though it does not enable us to determine the true rate of motion in the general system of atmospherical circulation, yet it assures us that it is not less on the average than a certain rate.

I do not offer these remarks as an explanation with which we ought to rest satisfied; I rather offer them in the true philosophical spirit of the distinguished microscopist himself:—simply as affording, as far as they are entitled to be called explanation, that explanation which is most in conformity with the facts before us, and which is suggested by the results of a novel and beautiful system of philosophical research.

Thus, though we have tallied the air, and put labels on the wind to "tell whence it cometh and whither goeth," yet there evidently is an agent concerned in the circulation of the atmosphere, whose functions are manifest but whose presence has never yet been recognised.

Where the air, which the N. E. trade winds meet in the equatorial calms, that of the S. East, and the two rise up together, what is it, where is the power which guides that from the North over to the South, and that from the South up to the North?

The following hypothesis on the relation "between magnetism and the circulation of the atmosphere," may perhaps throw some light upon the answer to this question:

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*On the probable Relation between Magnetism and the Circulation of the Atmosphere.**

The discoveries of Faraday in dia-magnetism are calculated to guide me and to illuminate the darkness in which many a philosopher has, no doubt, often found himself surrounded, as he has endeavored to follow "the wind in his circuits" over the trackless wastes of the ocean.

* See letter to Hon. Wm. A. Graham, January 30, 1851; Appendix Washington Astronomical Observations, 1846.

Oxygen, philosophers now say, composes one-fifth part of the atmosphere, and is magnetic.

The discovery that the oxygen of the atmosphere is magnetic, presents itself to the mind as a great physical fact, which perhaps is to serve as the keystone for some of the most grand among the sublime and beautiful structures which philosophy is erecting for monuments to the genius of the age.

The facts elicited from the Wind and Current Charts had, before I was aware of Faraday's discoveries, pointed me to the work of some agent whose office in the grand system of atmospherical circulation was neither understood nor recognised.

In following these facts to their legitimate conclusions, and in studying all the phenomena that these charts have successfully revealed touching the grand system of the distribution of moisture and the circulation of the atmosphere over the surface of the earth, I have often been induced to suspect that some other agent besides heat and the rotation of the earth on its axis, was concerned in creating the currents of the sea as well as the currents of the atmosphere.

Never suspecting the character of this agent for the atmosphere, its foot prints, at least, have at last been detected; and there is reason to suppose that Faraday has discovered its lurking place to be in the oxygen of the atmosphere. Can there be in the oxygen of the water, too, a magnetic force capable of influencing the currents of the sea?

These charts had enabled me to trace from the belt of calms, near the tropic of Cancer, which extends entirely across the seas, an efflux of air both to the North and to the South; from the South side of this belt the air flows in a never-ceasing breeze, called the N. E. trade winds, towards the equator.

On the North side of it, the prevailing winds come from it also; but they go towards the N. E. They are the well known southwesterly winds which prevail along the route from this country to England in the ratio of two to one.

Now these last named winds are going from a warmer to a colder climate; and therefore it may be supposed that nature exacts from them what we know she exacts from the air under similar circumstances, but on a smaller scale before our eyes, viz: more precipitation than evaporation.

Where then does the vapor, which these winds carry along, come from? was one of the questions suggested by the charts.

They afford grounds for the supposition that the air of which the N. E. trade winds are composed, and which comes out of the same zone of calms, as do these southwesterly winds, so far from being saturated with vapor at its exodus, is dry;—the N. E. trade winds are for the most part dry winds;—reason suggests, and philosophy teaches, that going from a lower to a higher temperature the evaporating powers of these winds are increased: that they have to travel in their oblique course, towards the equator, a distance of nearly 3,000 miles; that as a general rule they evaporate all the time, and all the way, and precipitate little or none on their route; investigations have proven that they are not saturated with moisture until they have arrived fully up to the regions of equatorial calms, a zone of constant precipitation.

This calm zone of Cancer borders also, it was perceived, upon a rainy region.

Where then does the vapor, which is here on the northern edge of this zone of Cancer, condensed into rains—and where also does the vapor which the rain winds that flow out on the polar side of this zone—where?—was the oft-repeated question—does the vapor which is condensed into rains for the extra-tropical regions of the North, come from?

Could it be taken up by the N. E. trade winds; and could it be the residuum, which, after supplying the equatorial calms with their rain, was carried up in the ascending column of air there, and which residuum was brought back in the upper regions of the atmosphere by the current which we know perpetually blows up there, counter to the trade winds: could this be so?

We know that there is an upper current of perpetual winds from the equatorial to the tropical calms,—that the volume of air moved by these two upper currents, North and South, to Cancer and to Capricorn, is equal to the volume that is felt on the surface, as the N. E. and S. E. trade winds.

I know of no law of nature or rule of philosophy which would forbid the supposition that the air which has been brought along as the N. E. trade winds to the equatorial calms, should after ascending there, return by the counter and upper currents to the calm zone of Cancer, here descend and re-appear on the surface as the N. E. trade winds again. I knew of no agent in nature which would *prevent* it fiom taking this circuit, nor did I know of any which would compel it to take this circuit; but while I knew of no agent in nature that would prevent it from taking this circuit, I knew on the other hand, of circumstances which rendered it probable that such in general is not the course of atmospherical circulation—that it does not take this circuit. I speak of the rule, not of the exceptions; these are infinite, and for the most part are caused by the land.

And I moreover knew of facts which greatly strengthen the supposition, that the winds which have come in the upper regions of the atmosphere from the equator, do not, after arriving at the calms of Cancer and descending, return to the equator on the surface; but that they continue on the surface towards the pole.

Such are the circumstances which favor the conjecture that the winds which flow in the upper regions of the atmosphere from the equator to the calms of Cancer, do not, after arriving and descending in the midst of these calms, turn about and go back to the equator with the N. E. trades: on the contrary, the following are the facts and circumstances which give strength to the supposition that these winds continue from the calm belt of Cancer towards the pole, as the prevailing southwesterly winds of the extra-tropical North:

We have seen that on the North side of this calm zone of Cancer, the prevailing winds on the surface are from this zone towards the pole; in other words, if s represent the total volume of atmosphere which blows on the surface towards the North on the polar side of Cancer, and ϕ the total volume which moves on the surface from the pole towards the calms of Cancer, then s being the rule and ϕ the exception, we shall have $s > \phi = s'$. Therefore s' is the quantity which must return in the upper regions of the atmosphere from the Arctic regions to the calm zone of Cancer; and if we take δ'' as the quantity which comes from the equator in the upper regions of the atmosphere to this same zone of calms, we shall have the momentum of δ'' equal to the momentum of s' as intimated by nature in the fact that she has established near each tropic, a zone, or belt of calms.

The Cancer zone of calms in the Atlantic ocean is known to American seamen as the "Horse Latitudes," from the circumstance that the vessels formerly engaged in carrying horses from New England to the West Indies, found it so difficult to cross this zone: they would often be detained in the calms for many days, during which time the large cargo of horses would exhaust the stock of water, become frantic with thirst, and to save a part, the rest would have to be thrown overboard; hence the name of "Horse Latitudes" to the calms near the tropics of Cancer, and which I have called by the name of that sign.

This is the place where the upper currents of air represented by s' and δ'' meet; they balance each other, produce a calm, and descend to re-appear as surface winds, one blowing to the North and the other to the South from this calm belt.

Now s' could not bring the vapors here which form the rains that are precipitated between this calm belt and the polar regions, because s' has already performed the circuit as a surface wind between this zone and those regions; because in that circuit it had been subjected to a temperature far below zero, and had given out all the moisture that a dew point so very low could extract from it; and as it had returned in the upper regions of the atmosphere where it encountered no fluid surface to replenish it with moisture, it had no vapor on its arrival from the North at the calms of Cancer, to make rains of, except such as it may have evaporated from the clouds, formed in the upper regions of the surface wind.

Hence if s' returned to the North as a surface wind after descending in the calm zone of Cancer, it would first have to remain a long time in contact with the sea, in order to be supplied with vapor enough to fill the great rivers, and supply the rains for the whole Earth between us and the North pole.

In this case we should have an evaporating region on the North as well as on the South side of this zone of Cancer; but the charts show no such region; I speak exclusively of the ocean.

Therefore I think I perceive plausibility in the inference that s' does not come out on the North side of this calm zone of Cancer, but on the South side; that thence it takes the circuit of the N. E. trade winds, in which it is replenished with vapor. Now if it be admitted that such is the general course of s' it must of necessity be admitted that δ'' probably re-appears on the North side of this zone, as the prevailing surface wind which precipitates on its way to the Arctic regions, the residuum of the vapor which it has taken up in the trade wind region, and brought from the equatorial calms.

Moreover, if these premises be admitted thus far, and if it be true that δ'' have the vapor which by condensation is to water with showers the extra-tropical regions of the northern hemisphere, nature we may be sure, has provided a guide for conducting δ'' across this belt of calms, and for sending it on in the right way. Here it is at this crossing of the winds that I thought I first saw the foot prints of an agent whose character I could not comprehend. It was this guide to s' and δ''.

Heat and cold, the early and the latter rain are not distributed over the Earth by chance; they are dispensed no doubt according to design, and in obedience to laws that are as certain and as sure in their operations as the seasons in their rounds.

If there were really, in the calms of Cancer, a general mingling of the atmosphere which comes from the

North with that which comes from the South—of the moist and the dry air as it descends here to the s of the Earth—if it depended upon chance whether the dry air should come out on this side, or on th their calm belt;—or whether the moist air should return whence it came or not; if such were the ca nature, we perceive, that so far from any regularity as to seasons, we should have, or might have, ye droughts the most excessive, and then again seasons of rains the most destructive; but so far from thi find for each place a mean annual proportion of both, and that too so regulated withal, that year after ye quantity is preserved with remarkable regularity.

Therefore, seeing reasons why *s'* and *v'* should cross each other in the calms of Cancer, and seein reasons why they should not, I was led to the inference that here probably is a node in the circulation o atmosphere, where the wind from the North meets the wind from the South; and that each, after a pause, tinues on its course and returns again to complete his circuit. The fact, it appeared to me, was probable the cause a mystery; for did this crossing of currents not take place, here would be a barrier in the at phere; and we, the inhabitants of the extra-tropical regions of the North, would have always to breath atmosphere, which circulates not over all parts of the Earth and in both hemispheres, but only in the N between the calms of Cancer and the Pole.

Having thus shown that there is no reason for supposing that the upper currents of air when they over the calms of Cancer and Capricorn, are turned back to the equator; but having shown that the reason for supposing that the air of each current after descending, continues on in the direction towards w it was traveling before it descended; we may go further, and by a similar train of circumstantial evidence, aff ed by the charts, and other sources of information, show that the air kept in motion on the surface by the systems of trade winds, when it arrives at the belt of equatorial calms, and having ascended, continues thence, each current towards the pole which it was approaching while on the surface.

There is no reason for supposing that the atmosphere does not pass freely from one hemisphere to anotl on the contrary, many reasons for supposing that it does, present themselves.

If it did not—the proportion of land and water, and consequently of plants and warm-blooded anim being so different in the two hemispheres—we might imagine that the constituents of the atmosphere in th would, in the course of ages, probably, become different; and that consequently in such a case, man could safely pass from one hemisphere to the other.

I considered the manifold beauties in the whole system of terrestrial adaptations:—I reflected wha perfect and wonderful machine is this atmosphere:—how exquisitely balanced and beautifully compensated is in all its parts.—We all know that it is perfect:—that in the performance of its manifold offices it is ne once left to the guidance of chance—no, not for a moment:—therefore I was led to ask myself why the of the N. E. trades, when arrived at the zone of equatorial calms, should, after ascending, rather ret to the North than to the South. Where and what is the principle upon which its course is decided?

Here again, I found circumstances which induced me to suppose it probable, that neither turned back the North, nor mingled with the air which came from the regions of the S. E. trades, ascended, and th flowed indiscriminately to the North or the South.

But I saw reasons for supposing that what came to the equatorial calms as the N. E. trade winds, continued to the South as an upper current; and that what had come to the same zone as S. E. trade winds, ascended and continued over into the northern hemisphere as an upper current, bound for the calm zone of Cancer.

And these are the principal reasons upon which this supposition was based:

At the seasons of the year when the Sun is evaporating most rapidly in the southern hemisphere, the most rain is falling in the northern. Therefore I supposed that much of the vapor which is taken up there is precipitated here.

The evaporating surface in the southern hemisphere is greater, much greater, than that in the northern: still all the great rivers are in the northern hemisphere:—the Amazon being regarded as common to both. And this, as far as it goes, is corroborative of the above.

Independently of other sources of information, the charts taught me to believe that the mean temperature of the tropical regions was higher in the northern than in the southern hemisphere; for they show that the difference is such as to draw the equatorial edge of the S. E. trades far over on this side of the equator, and to give them force enough to keep the N. E. trade winds out of the southern hemisphere almost entirely.

Consequently, as before stated, the S. E. trade winds being in contact with a more extended evaporating surface, and continuing in contact with it for a longer time, or through a greater distance, they would probably arrive at the trade wind place of meeting, more heavily laden with moisture than the others.

Taking the laws and rates of evaporation into consideration, I could find no part of the ocean of the northern hemisphere from which, according to the indications of the charts, the sources of the Mississippi, the St. Lawrence, and the other great rivers of our hemisphere could be supplied.

It appeared to me, therefore, that the extra-tropical regions of the northern hemisphere stood in the relation of a condenser to a grand steam machine, the boiler of which was in the region of the S. E. trade winds; and that the trade winds of this hemisphere performed the like office for the regions beyond Capricorn.

The calm zone of Capricorn is the duplicate of that of Cancer, and the winds flow from it as they do from that: both North and South: with this difference, that on the polar side of the Capricorn belt, they prevail from the N. W., instead of the S. W.; and on the equatorial side from the S. E. instead of N. E.

Now, if it were so, that the vapor of the N. E. trade winds were condensed in the extra-tropical regions of the southern hemisphere, the following path, on account of the effect of diurnal rotation of the earth upon the course of the winds, would represent the mean circuit of a portion of the atmosphere moving according to the general system of its circulation over the Pacific ocean, viz: coming down from the North as an upper current, and appearing on the surface of the earth in about longitude 130° W., and near the tropic of Cancer, it would here commence to blow the N. E. trade winds of that region.

Its course would be towards the equator, somewhat in the direction of the King's Mill group of Islands. Meeting no land in this long oblique track over the tepid waters of a tropical sea, it would, somewhere to the East of these Islands, arrive at the belt of equatorial calms, which always divides the N. E. from the S. E. trade winds.

Here depositing a portion of its vapor as it ascends, it would with the residuum take, on account of d
rotation, a course in the upper region of the atmosphere to the S. E. as far as the calms of Capricorn.
it descends and continues on towards the coast of South America in the same direction, appearing now
prevailing N. W. wind of the extra-tropical regions of the southern hemisphere.

Traveling on the surface from warmer to colder regions, it must, in this part of its circuit, preci
more than it evaporates.

Now it is a coincidence, at *least*, that this is the route by which, on account of the land in the northern he
phere, the N. E. trade winds have the fairest sweep over that ocean. That this is the route by which the
longest in contact with an evaporating surface: the route by which all circumstances are most favorable to c
plete saturation; and this is the route by which they can pass over into the southern hemisphere, most he
laden with vapors for the extra-tropical regions of that half of the globe; and this is the supposed route w
the N. E. trade winds of the Pacific take to reach the equator, and to pass from it.

Accordingly, if this process of reasoning be good, that portion of South America between the calm
Capricorn and Cape Horn, upon the mountain ranges of which this part of the atmosphere, whose circuit I
considering as a type, first impinges, ought to be a region of copious precipitation. I accordingly turne
the hyetography of Berghaus and Johnson, and find it stated, on the authority of Captain King, that upwa
of 12* feet of rain fell there in 41 days.

Passing the snow-clad summits of the Andes, this same wind tumbles down upon the eastern slo
of the range, and then traverses the almost rainless and barren regions of Patagonia and South Buenos Ay

These conditions, the direction of the prevailing winds, and the amount of precipitation, were regarded
evidence afforded by nature, if not in favor, certainly not against the conjecture that such had been the voya
of this vapor through the air. At any rate, here was proof of the immense quantity of vapor which the
winds of the extra-tropical regions carry along with them towards the poles, and I could imagine no ot
place than that suggested, whence these winds could get so much vapor.

I am not unaware of the theory or of the weight attached to it, which requires precipitation to take pla
in the upper regions of the atmosphere on account of the cold there, irrespective of proximity to mountain to
and snow-clad hills.

But the facts and conditions developed by these charts are in many respects irreconcilable with that theor
With a new system of facts before me, I have, independent of all preconceived notions and opinions, set abo
to seek among them for explanations and reconciliations.

Arrived at this stage in the process of deduction and finding conformity, the next step was to trace bac
the vapor that supplies the sources of the Mississippi river and its tributaries with rain, to its place in th
ocean whence it came; (for that the vapor of water is distributed over the earth by the winds, and not b
permeation, my researches abundantly prove.)

* 153 inches.

It rains more in the valley drained by that river than is evaporated from it again. The difference for a year is the volume of water annually discharged by that river into the sea.

At the time and place that the vapor which supplies this immense volume of water was lifted by the atmosphere up from the sea, it was reasoned that the thermometer stood higher than it did at the time and place where it was condensed and fell down as rain in the Mississippi valley.

I looked to the South for the springs in the sea which supply the fountains of this river with rain. But I could not find spare evaporating surface enough for it in the first place; and if the vapor, I could not find the winds which would convey it to the right place.

The prevailing winds in the Caribbean sea, and southern parts of the Gulf of Mexico, are the N. E. trade winds. They have their offices to perform in the river basins of tropical America, and the rains which they may discharge into the Mississippi valley now and then are exceptions, not the rule.

The winds from the North cannot bring vapors from the great lakes to make rains for the Mississippi, for two reasons; first: the basin of the great lakes receives from the atmosphere more water in the shape of rain than they give back in the shape of vapor. The St. Lawrence river carries off the excess.

2d. The mean climate of the lake is colder than that of the Mississippi valley; and therefore, as a general rule, the temperature of the Mississippi valley is unfavorable for condensing vapor from that quarter.

It cannot come from the Atlantic, because the greater part of the Mississippi valley is to the windward of the Atlantic ocean. The winds that blow across it go to Europe with their vapors; and in the Pacific, from the parallels of California down to the equator, the direction of the wind at the surface is from, not toward, the basin of the Mississippi. Therefore it seemed to be established, with some degree of probability—or if that expression be too strong—with something like apparent plausibility, that the rain winds of the Mississippi valley, as the general rule, do not get their vapors from the North Atlantic ocean, nor from the Gulf of Mexico, nor from the great lakes, nor from that part of the Pacific ocean over which the N. E. trade winds prevail.

The same process of reasoning which induced me to look to the trade-wind region of the northern hemisphere for the sources of the Patagonian rains, induced me to look to the trade wind regions of the South Pacific ocean, for the vapor springs of the Mississippi.

I therefore last summer addressed a circular letter to the farmers and planters of the Mississippi valley, requesting to be informed as to the direction of the rain winds of each locality; and with the view of acquiring some idea as to the general hygrometric condition of the atmosphere, I asked also to be informed as to the kind and quality of fruits and the like.

To this I have received the following replies;—

From J. M. Janney, Warren county, Ohio.

Lat. 39° 30′ N.; Long. 84° W.

Winds from the southwest, with but few exceptions, bring rain; this is the result of eleven and a half years' observation.

Farm situated between the Miami rivers. There are no mountains nearer than the Cumberland a Allegbany; the one lying in a southeast direction, and the other east of this locality. The nearest point these elevations is perhaps not short of 225 or 250 miles. Lake Erie, situated about 100 miles northeast us, is the nearest sheet of water.

The fruits are apples, pears, cherries, strawberries, raspberries, currants, gooseberries, quinces, a peaches. Grapes also thrive well. The products of the soil are maize, wheat, oats, flax, rye, and potato

I may observe that the cold South winds often prevail through the winter; and during the spring co rather piercing northwest winds frequently assail us; during the prevalence of which drought is almost st to exist. Snow-storms generally come from the southwest, but occasionally we have a heavy storm of tl kind from the East. To me it is obvious that the winds that bring us rain sweep through the great Mississip and Ohio vallies in their course northeast. [That is, they are southwest winds.]

From Wm. J. Payne, near Rushville, Rush county, Indiana.

Lat. 39° 30′ N.; Long. 85° 30′ W.

The winds are various; the West wind sometimes bring most rain during some years, but the southwe winds are more prevalent, and bring rain the greatest number of years.

Fruits are, peaches, apples, pears, and cherries.

Productions—Corn, wheat, oats, rye, &c.

From Louis Moore, Carrollton, Mississippi.

Lat. 33° 30′ N.; Long 90° W.

On an average, the winds that bring us rain are the southwest. Farm situated in a hilly district, som 150 miles from the sea-coast. The most common fruits are apples, peaches, &c., and melons in abundanc Agricultural staples are cotton, corn, oats, potatoes, &c.

From Turner Vaughan, La Guardo, Tennessee.

Lat. 36° 30′ N.; Long. 86° 30′ W.

Winds S. by W. bring the most rain, and W. N. W. the most storms; the latter, however, are unfrequen here, and very partial, owing, perhaps, to remoteness from the sea.

Whenever the lightning appears to linger in the North at eventide, rain almost invariably follows speedily not so in South.

Farm situated twenty-five miles above Nashville; surface undulating, abounding in lime-stone. Hem and corn do well, tobacco, also; wheat and cotton inferior; grapes tolerable.

From Thomas Meaux, Amelia county, Virginia.

Lat. 37° 20′ N., Long. 78° W.

Point of observation about thirty miles W. S. W. from Richmond.

Prevalent wind in spring, summer, and autumn from S. W., rain falling in showers during these seasons. Gusts and tornadoes, with black clouds, come from N. W. in late summer; protracted rains in spring and fall come from N. E.

Prevalent winds in winter E. to W. northwardly. Rains and snows in winter from N. E. Lowest observed temperature 6° Fahrenheit, at sunrise, Jan. 29, 1844; highest, 97°, noon, in shade, 20 July, 1844.

These observations made for twenty years.

From Willis Fawcett, St. Charles, Missouri.

Lat. 39° N., Long. 90° 30′ W.

Wind from any point of the eastern half of the horizon will bring rain generally, after blowing twelve hours. It frequently happens that we have winds in a dry time to blow much longer, even several days, from that direction, without rain; but on the wind's shifting to the opposite side, we are sure of rain. I think our rains during summer come most frequently from the S. E. Wind from the S. W. is generally accompanied by good dry weather. West and N. W. are dry. I have noticed that thunder and lightning in the North is almost invariably followed here by storms of rain and hard winds within twelve or twenty-four hours.

My farm is on an alluvial prairie plain,(probably formed by the washings of the Missouri and Mississippi) six miles below St. Charles.

The apple is our main dependence. Peaches also flourish finely; as do plums, cherries, (except the black,) strawberries, gooseberries, wild and cultivated. Wheat and corn are the principal productions. Timothy hay will soon be exported from our neighborhood to a considerable extent. I cultivate wheat and corn almost exclusively.

These answers, as far as they go, show that the S. W. winds—the winds suggested by the charts—are, except in Western Missouri, the rainy winds. These winds, like those between the same parallels upon the ocean, are going from a higher to a cooler temperature; and these winds in the Mississippi valley, not being in contact with the ocean, or with any other evaporating surface to supply them with moisture, must bring the moisture with them from some sea or another.

Therefore, though it may be urged, inasmuch as the winds which brought the Patagonia rains came direct from the sea, that they therefore took up their vapors as they came along; yet it could not be so urged in this case; and if these winds could pass with their vapors from the equatorial calms through the upper regions of the atmosphere to the calms of Cancer, and then as surface winds into the Mississippi valley, it was not perceived why the Patagonian rain winds should not bring their moisture by a similar route. These last are from the N. W., from warmer to colder latitudes; therefore, being once charged with vapors they must precipitate as they go, and take up less moisture than they deposit.

This was circumstantial evidence. No fact had yet been elicited to prove that the course of atmospherical circulation suggested by my investigations is the actual course in nature. It is a case in which I could yet hope for nothing more direct than such conclusions as might legitimately flow from circumstantial evidence.

My friend Lieut. De Haven was about to sail in command of the American Expedition in search of John Franklin. Infusoria are sometimes found in sea-dust, rain-drops, hailstones or snowflakes; and if any chance it should so turn out that the *locus* of any of the microscopic infusoria which might be foı descending with the precipitation of the Arctic regions should be indentified as belonging to the regions of S. E. trade winds, we should thus add somewhat to the strength of the very slender clue by which we w seeking to enter into the chambers of the wind, and to "tell whence it cometh and whither it goeth."

It is not for man to follow the "wind in his circuits," and all that could be hoped was, after a cl examination of all the facts and circumstances which these charts have placed within my reach, to point that course which seemed to be most in accordance with them, and then having established a probability or ev a possibility as to the true course of atmospheric circulation, to make it known and leave it for future inves gations to confirm or set aside.

It was at this stage of the matter* that my friend Baron von Gerolt, the Prussian Minister, had the kin ness to place in my hand Ehrenberg's work, "Passat-Staub und Blut-Regen."

Here I found the clue which I hoped, almost against hope, De Haven would place in my hands.

That celebrated microscopist reports that he found South American infusoria in the blood-rains, and se dust of the Cape Verd Islands,—Lyons, Genoa, and other places.

Thus confirming, as far as such evidence can, the indications of the "Wind and Current Charts," ar increasing the probability that the general course of atmospherical circulation is in conformity with the sugge tions of the charts as I had interpreted them, viz: that the trade winds of the southern hemisphere aft arriving at the belt of equatorial calms ascend and continue in their course towards the calms of Cancer as a upper current from the S. W., and that after passing this zone of calms, they are felt on the surface as the pr vailing S. W. winds of the extra-tropical parts of our hemisphere; and that for the most part they bring the moisture with them from the trade wind regions of the opposite hemisphere.

Continuing on towards the North pole from the S. W. they enter the Arctic regions on a spiral curve continually lessening the gyrations until, whirling about in a *direction contrary to the hands of a watch*, thi air ascends and and commences its return as an upper current towards the calms of Cancer.

It returns to this zone from the opposite direction, N. E., by which it approached the pole.

The atmosphere in this part of the circuit is moving in the direction called s' in a previous part of thi paper.

Arrived at the calms of Cancer, s' meets d'' in the upper regions of the atmosphere.

They both descend—and the fact that the barometer stands higher here† than upon any other parallel shows that here there is an increased atmospheric pressure, caused in part by accumulation produced by the opposing forces of s' and d''; and in part by the downward currents.

*See my letter to him, in another part of this work, also, paper read by me before the American Association at its meeting in Charleston, March, 1850.

† Humboldt.

Having descended, δ' is forced out on the equatorial side of the zone, and appears on the surface as Δ—the N. E trade winds—and so continues until it reaches the belt of equatorial calms.

Here then is precipitation, an ascent of atmosphere, and a fall of the barometer; Δ now becomes δ or an upper current flowing in a S. E. direction—*i. e.*, from N. W. towards the zone of the calms of Capricorn. Here it is met by the upper current from the Antarctic regions, descends with a rise in the barometer again, and appears on the polar side of this zone of calms, as Δ'—the prevailing N. W. surface winds in the extra-tropical regions of the southern hemisphere.

Δ' now approaches the Antarctic regions in a *spiral*, *gyrating with* the hands of a watch and contracting its convolutions as it draws nearer and nearer the pole, where theoretically there is another atmospherical node in which Δ' ascends with a low barometer, and commences its return towards the equator as δ' in the upper regions of the atmosphere.

The same cause—diurnal rotation—which made the Δ' on the surface to approach from the N. W., now operates to make it return as δ' in the direction whence it came.

Arriving in the upper regions at the calm zone of Capricorn δ meets δ'; the two descend, and δ' continues to flow towards the equator as Δ', the S. E. trade wind.

Arrived at the zone of equatorial calms, it ascends, and continues thence in the upper regions of the atmosphere as δ'', until it reaches the calm zone of Cancer. Here it descends, and continues on as the S. W. passage winds of the northern hemisphere, whose circuit has been already described.

Thus, at the risk of repetition and of being thought tedious, I have described the progress which investigations connected with the Wind and Current Charts had enabled me to make in the theory of atmospherical circulation; and I have presented that theory as far as it had been developed in my own mind, when I received yesterday No. 1, vol. i, 4th series, of the London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, containing a synopsis of Dr. Faraday's "Experimental Researches in electricity," 24th 25th, 26th, and 27th series; and also the letter of Prof. Von Feilitzsch on the *Physical distinction of Magnetic and Diamagnetic Bodies.*

This account, though meagre, is the first account that I have seen of the Doctor's discoveries relative to the magnetism of the atmosphere.

A new era in our knowledge of the laws, and the agents concerned in the general system of atmospherical circulation, will probably be dated from these discoveries.

With the accounts of them before me, I feel somewhat in the condition of the tempest-tossed mariner who has been buffeting with the waves in storm, clouds, and darkness, until he feels himself almost bewildered and lost in the mist that surrounds him; when suddenly a light appears, and, like the grateful mariner, I wished, before taking a fresh departure, to bring up my reckoning, and to ascertain how far I was out, in order to show how great was the service rendered by the sympathising hand which put forth that light.

Dr. Faraday has shown that, as the temperature of oxygen is raised, its paramagnetic force diminishes, being resumed as the temperature falls again.

"These properties it carries into the atmosphere, so that the latter is, in reality, a magnetic medium, ever "varying, from the influence of natural circumstances, in its magnetic power. If a mass of air be cooled, it "becomes more paramagnetic; if heated, it becomes less paramagnetic, (or diamagnetic,) as compared with "the air in a mean, or normal condition."*

Now, is it not more than probable that here we have in the magnetism of the atmosphere that agent which guides the air from the South through the calms of Capricorn, of the equator, and of Cancer, and conducts it into the North; that agent which causes the atmosphere with its vapors and infusoria to flow above the clouds from one hemisphere into the other, and whose foot-prints had become so palpable?

With the lights which these discoveries cast, we see why that air, which has completed its circuit to the whirl† about the Antarctic regions should then, according to the laws of magnetism, be repelled from the South, and attracted by the opposite pole towards the North.

And when the S. E. and the N. E. trade winds meet in the equatorial calms of the Pacific, would not these magnetic forces be sufficient to determine the course of each current:—bringing the former with its vapors of the southern hemisphere over into this by the courses already suggested?

This force and the heat of the sun, would propel it to the North. The diurnal rotation of the earth propels it to the East; consequently its course first through the upper regions of the atmosphere, and then on the surface of the earth, after being conducted by this newly discovered agent across the calms of Cancer, would be *from* the southward and westward to the northward and eastward.

These are the winds which, on their way to the North, from the South Pacific, would pass over the Mississippi valley, and they appear to be the rain winds there. Whence then, if not from the trade wind regions of the South Pacific, can the vapors for those rains come?

According to this conjecture, and not taking into account any exceptions produced by the land and other circumstances upon the general circulation of the atmosphere over the ocean, the S. E. trade winds which reach the shores of Brazil near the parallel of Rio, and which blow thence for the most part over the land, should be the winds which, in the general course of circulation, would be carried towards northern Africa, Spain, and the South of Europe.

They might carry with them the infusoria of Ehrenberg, but, according to his theory, they would be wanting in moisture. Now, those portions of the old world are for the most part dry countries, receiving but a small amount of precipitation.

Hence the general rule: these countries to the North of the calms of Cancer, which have large bodies of land situated to the southward and westward of them in the S. E. trade wind region of the Earth should have a scanty supply of rain, and *vice versa.*

Now, the extra-tropical part of New Holland comprises a portion of land thus situated in the southern hemisphere. Tropical India is to the northward and westward of it; and tropical India is in the N. E. trade

*Phil. Mag. and Journal of Science, 4th Series, No. 1, January, 1851, page 73.

†"It whirleth about continually."—*Bible.*

wind region, and should give extra-tropical New Holland a slender supply of rain. But what modifications the monsoons of the Indian ocean may make to this rule, or what effect they may have upon the rains in New Holland, my investigations in that part of the ocean have not been carried far enough for a decision.

Taking up the theory of Ampère with regard to the magnetic polarity induced by an electrical current, according as it passes through wire coiled *with* or coiled *against* the sun, and expanding it in conformity with the discoveries of Faraday, we perceive a series of facts and principles which, being applied to the circulation of the atmosphere, make the conclusions to which the charts have led me touching the continual "whirl" of the wind in the Arctic regions *against*, and in the Antarctic *with the hands of a watch*, very significant—much more so than I had supposed them to be.

In this view of the subject we see light springing up from various sources, by which the shadows of approaching confirmation are clearly perceived. One such source of light have we from the university of Greifswald, in Prussia.

Likening the atmosphere with its magnetic spirals of oxygen to the coils of a wire, and the poles of the earth to the ends of the helix used by Professor Von Feilitzsch, we might almost fancy that he was experimenting expressly with the view of throwing light upon the general course of atmospherical circulation.

"If," says he in his letter to Dr. Faraday, "we observe two such neighboring particles near the external "South pole, then will the more near repel a South pole with the intensity s; the more distant will turn to a "North pole with the intensity n', but in such a manner that $n' < s$. But outwardly these two excited mag-"netisms act with the difference of their power $s - n'$; but this is in one case *South polar*, consequently of the "same kind as the exciting South pole. The contrary will take place near the North pole, so that the *disen-"gaged magnetism distributed over the bar becomes South polar on that half which is turned to the South pole, "but North polar on the other half that is turned to the North pole.* A substance where this takes place is "*diamagnetic*, it places itself equatorial.

"When the bar of a magnetic substance is so qualified that the separating action of the molecules on each "other must be taken into consideration, then it can become so strong that the molecules in the middle of the "substance are more strongly magnetic than towards the ends. If we observe once more two such particles "near two such particles near the external South pole, the South pole of the nearest will tend to recede by an "intensity ${}^{s}_{1}$ from this external South pole, but the more distant will turn towards it a North pole of the in-"tensity n'_1 but in such a manner that $n'_1 < {}^{s}1$. Outwardly the two will act with the intensity $n'{}^{s}_{1} - {}^{s}_{1}$ but this "is North polar, therefore of a contrary nature to the exciting South pole. The contrary will take place near "the pole, so that the *disengaged magnetism distributed over the bar becomes North polar on the half that is "turned to the South pole, but South polar on that half which is turned towards the North pole.* A substance "where this takes place is *magnetic*, it places itself *axial*."*

"Applying the former to the theory of Ampère, I was startled because it has hitherto taught only that "currents which are parallel and directed in the same way attract, but if they are parallel and not directed in

*Page 48.

" the same manner they are repulsive; therefore that a current moving in the direction of the hands of a wa
" in a spiral produces a South pole on the entrance point in the spiral, but a North pole on the egression pc
" Hitherto only such spirals have been constructed in which the current in every winding shows an e
" intensity."

" But I tried to arrange spirals of the following kind :—one of them is in such a way constructed that " two copper wires are soldered, to each of them, fifteen thin wires covered over with silk. The first wind " backwards over the copper wire, i. e. the first convolution of the helices, beginning at the end and proce " ing towards the centre, is with all the fifteen wires, the second winding is only wound with 14 threads, wh " the fifteenth is carried along the axis, &c.; consequently every convolution of the fifteen windings ha " thread less, and the ends of all the other threads have direction of the axis. The ends of the fifteen thre " are soldered in the middle, and the two thick wires without touching each other, are so bent that they c " be suspended in the little cups of the apparatus of Ampère, then a current passing through the spiral v " divide itself in such a manner that it is most strong on the external ends of the spiral but decreases m " and more to the middle. If the windings of the spiral took place in the direction of the hands of a watc " then the end of it where the current enters will become a South pole, but a *North pole*, kept parallel to t " spiral, *will repel it*, only the final convolution will be attracted, and it represents the disengaged magnetis " of the final surface."

" A second spiral is wound like that described, only with this difference, that the strongest convolutio " are in the middle, and the feeblest near the ends. This spiral will be attracted by the North pole of a magn " over the half in which the current moves at first or enters, but the other half will be repulsed by it. Tl " third spiral has the winding the same strength over the whole extent; it is indifferent to a magnet pole whic " is not too near and only the final convolutions are attracted or repulsed."

" Therefore it is permitted to enlarge the theory of Ampère in this manner:

"—If an electric current passes through a spiral in the direction of the hand of a watch, and,

" *a* If the current is more feeble in every winding as it is nearer to the centre of the spiral, then that ha " is attracted by a South pole in which the current enters, except the first winding.

" *b* But if the current is stronger in every winding as it is nearer to the centre of the spiral, then that hal " is repulsed by a South pole in which the current enters, including the first winding.

" The contrary will be the case for that half in which the current leaves the helix, and likewise for the " North pole of the magnet opposed."*

Attentively considering the experiments of the Professor of Griefswald, we may trace an analogy between his spirals and the spirals which the currents of the wind in "his circuits" describe about the Earth. At the South polar calms, the atmospherical spiral is with the hand of the watch, and as in the case of a spiral so wound about its helix the magnetism is South polar; and so *mutatis mutandis* for the regions of North polar calms.

*Page 49, 50, Phil. Mag.

May we not look therefore to find about the North and South magnetic poles these atmospherical nodes or calm regions, which I have theoretically pointed out there? In other words, are not the magnetic poles of the earth in those atmospherical nodes, the two standing in the relation of cause and effect, the one to the other?

And have we not a clue already placed in our hands by which the motion of the circular storms of the northern hemisphere which are said to travel *against*, and those of the southern which are said to travel *with* the hands of a watch, seems to be connected with the like motion of the wind of each hemisphere in its circuit about its pole? and will not this clue when followed up lead us into the labyrinths of atmospherical magnetism for the solution of the mystery?

Indeed so wide for speculation is the field presented by these discoveries, that we may in some respects regard this great globe itself with its "cups" and spiral wires of air, earth and water, as an immense "pile" and helix, which being excited by the natural batteries in the sea and atmosphere of the tropics, excites in turn its oxygen, and imparts to atmospherical matter the properties of magnetism.

Thus, though it be not proved as a mathematical truth, that magnetism is the power which guides the storm from right to left, and from left to right;—which conducts the moist and the dry air each in its appointed paths;—and which regulates the "wind in his circuits;"—yet that it is such a power, is rendered so very probable that the onus is now shifted, and it remains not to prove, but to disprove that such is its agency.

*Of Clouds and the Equatorial Cloud-Ring.**

During the progress of these investigations, the attention is frequently arrested by proof of the exquisite skill which has been displayed in the construction of the atmospherical machinery of the Earth:—in wonder and admiration, we pause to contemplate its beautiful mechanism—its surprising performance.

Among the many striking features which this system of research presents for contemplation, the imagination dwells with peculiar delight upon those which are brought out in tracing the offices which are assigned to the clouds in the terrestrial economy.

One need not go to sea to perceive the grand work which the clouds perform in collecting moisture from the crystal vaults of the sky, in sprinkling it upon the fields, and making the hills glad with showers of rain. Winter and summer, "the clouds drop fatness upon the Earth." This part of their office is obvious to all; and I do not propose to consider it now.

But the sailor at sea observes phenomena, and witnesses operations in the terrestrial economy which tell him, that in the beautiful and exquisite adjustments of the grand machinery of the atmosphere, the clouds have other important offices to perform besides those merely of dispensing showers, of producing the rains, and of weaving mantles of snow for the protection of our fields in winter. As important as is this office, the philosophical mariner is reminded that the clouds have other commandments to fulfill, which, though less obvious,

*Read before the American Association at its meeting in Albany, New York, Aug. 1851.

are not therefore the less benign or the less worthy of his notice. He beholds them at work in moderating extremes of heat and cold, and in mitigating climates. At one time they spread themselves out; they c the Earth as with a mantle; they prevent radiation from its crust, and keep it warm; at another time, interpose between it and the Sun, and screen it from his scorching rays, to protect the tender plants from heat, the land from the drought. Having performed this office for one place, they are evaporated and gi up to the sunbeam and the wind again, to be borne on their wings away to other places which stand in n of like offices.

Familiar with clouds and sunshine, the storm and the calm, and all the phenomena which the lightn and the blast present, the right minded mariner as he contemplates "the cloud without rain," ceases to reg it as an empty thing; he perceives that it performs many important offices; he regards it as a great moder of heat and cold—as a "compensation" in the atmospherical mechanism which makes the performance of grand machine perfect. Bound in his ship hence to the southern hemisphere, he enters the regions of the N. trades, and finds the sky sometimes mottled with clouds, but for the most part clear: continuing his cou towards the Line, he finds his thermometer to rise higher and higher as he approaches the equator, until ent ing the region of equatorial calms and rains, he feels the weather to become singularly oppressive; he discov here that the elasticity of feeling which he breathed from the trade wind air, has forsaken him.

Escaping from this gloomy region, and entering the S. E. trades, his spirits revive, and he turns to Log-book to see what changes are recorded there. He is surprised to find, that notwithstanding the oppr sive weather of the rainy latitudes, both his thermometer and barometer stood, while in them, lower than the clear weather on either side of them; that just before entering, and just before leaving the rainy paralle the mercury of the thermometer and barometer invariably stands higher than it does when within them, ev though they include the equator. He has passed a ring of clouds that encircles the earth.

Perceiving this, he is reminded how this cloud-ring, by screening these parallels from the Sun's ray not only promotes the precipitation which takes place within them, at certain periods, but how also the rai are made to change the places upon which they are to fall; and how, by travelling with the calm belt of t equator up and down the earth, this cloud-ring shifts the surface from which the heating rays of the Sun a excluded; and how, by this operation, tone is given to the atmospherical circulation of the world.

In the ransacking of garrets and old sea chests, to which these researches have given rise for Log-book one of rare value, kept by a brother officer many years ago, has turned up. It is the journal of the la Commander Arthur Sinclair, kept on board the United States frigate "Congress" during a cruise to Sout America, in 1817–'18. The picture which he has drawn of the weather under this *equatorial cloud-rin* is singularly graphic and striking. He encountered this cloud-ring in the month of January, 1818, betwee the parallel of 4° N. and the equator, and from the longitude of 19° and 23° West: he says of it:

"This is certainly one of the most unpleasant regions in our globe. A dense, close atmosphere, excep for a few hours after a thunder storm, during which time torrents of rain fall, when the air becomes a littl refreshed; but a hot glowing Sun soon heats it again, and but for your awnings and the little air put in cir

culation by the continual flapping of the ship's sails, it would be almost insufferable. No person, who has not crossed this region, can form an adequate idea of its unpleasant effects. You feel a degree of lassitude unconquerable, which not even the sea bathing, which every where else proves so salutary and renovating, can dispel. Except when in actual danger of shipwreck, I never spent twelve more disagreeable days in the professional part of my life, than in these calm latitudes.

"I crossed the Line on the 17th of January, at 8 A. M., in longitude 21° 20′, and soon found I had surmounted all the difficulties consequent to that event; that the breeze continued to freshen and draw round to S. S. E., bringing with it a clear sky and most heavenly temperature, renovating and refreshing beyond description. Nothing was now to be seen but cheerful countenances, exchanged as by enchantment, from that sleepy sluggishness which had borne us all down for the last two weeks."

In a clear day at the equator, this cloud-ring having slid to the North or South with the calm belt, the rays of the Sun pour down upon the crust of the earth and raise its temperature to a scorching heat. The atmosphere dances above it, and the air is seen trembling in ascending and descending columns with busy eagerness to conduct the heat off, and deliver it to the regions aloft, where it is required to give momentum to the air in its general channels of circulation. The dry season continues; the Sun is vertical; and finally the earth becomes parched and dry; the heat accumulates faster than the air can carry it away; the plants begin to wither, and the animals to perish. Then comes the mitigating cloud-ring. The burning rays of the Sun are intercepted by it. The place for the absorption and reflection, and the delivery to the atmosphere of the solar heat is changed; it is transferred from the upper surface of the Earth to the upper surface of the clouds.

Radiation from the land and the sea below the cloud belt is thus interrupted, and the excess of heat in the Earth is delivered to the air, and by absorption carried up to the clouds, and there delivered to their vapors to prevent excess of precipitation.

In the mean time, the trade winds North and South are pouring into this cloud-covered receiver, as the calm and rain belt of the equator may be called, fresh supplies in the shape of ceaseless volumes of heated air loaded to saturation with vapor, which has to rise above and get clear of the clouds before it can commence the process of cooling by radiation. In the mean time, also, the vapors which the trade winds bring from the North and the South, expanding and growing cooler as they ascend, are being condensed on the lower side of the cloud stratum, and their latent heat is set free, to check precipitation and prevent a flood.

While this process and these operations are going on on the nether side of the cloud-ring, one not less important is going on on the upper side. There, from sunrise to sunset the rays of the Sun are pouring down without intermission. Every day, and all day long, they operate with ceaseless activity upon the upper surface of the cloud stratum. When they become too powerful, and convey more heat to the cloud vapors than the cloud vapors can reflect and give off to the air above them; then with a beautiful elasticity of character, the clouds absorb the surplus heat. They melt away, become invisible, and retain, in a latent and harmless state, until it is wanted at some other place and on some other occasion, the heat thus imparted.

We thus have an insight into the operations which are going on the equatorial belt of precipitation,

and this insight is sufficient to enable us to perceive that exquisite indeed are the arrangements which nat has provided for supplying this calm belt with heat, and for pushing the snow line there, high up above clouds, in order that the atmosphere may have room to expand, to rise up, overflow, and course back into channels of its circulation. As the vapor is condensed and formed into drops of rain, a two-fold objec accomplished: coming from the cooler regions of the clouds, the rain drops are cooler than the air and ea below. They descend, and by absorption take up the heat which has been accumulating in the earth's cr during the dry season, and which cannot now escape by radiation. Thus this cloud-ring modifies the clim of all places beneath it; over-shadowing at different seasons all parallels from 5° S. to 15° N.

In the process of condensation, these rain drops on the other hand have set free a vast quantity of late heat, which has been gathered up with the vapor from the sea by the trade winds and brought hither. T caloric thus liberated is taken by the air and carried up aloft still further to keep, at the proper distance fr the Earth, the line of perpetual congelation. Were it possible to trace a thermal curve in the upper regions the air to represent this line, we should no doubt find it mounting sometimes at the equator, sometimes on th side, and sometimes on that, of it; but always so mounting as to overleap this cloud-ring. This thermal li would not ascend always over the same parallels, it would ascend over those between which this ring happe to be; and the distance of this ring from the equator is regulated according to the seasons.

If we imagine the atmospherical equator to be always where the calm belt is which separates the N. I from the S. E. trade winds, then the loop in the thermal curve which should represent the line of perpetu congelation in the air would be always found to stride this equator, and it may be supposed that a the mometer kept sliding on the surface of the earth so as always to be in the middle of this rain belt, would she very nearly the same temperature all the year round; and so too would a barometer, the same pressure.

Returning and taking up the train of contemplation as to the office which this belt of clouds, as encircles the earth, performs in the system of cosmical arrangements, we may see that the cloud-ring an calm zone which it overshadows perform the office both of ventricle and auricle in the immense atmospherica heart, where the heat and the forces which give vitality and power to the system are brought into play— where dynamical strength is gathered, and an impulse given to the air, sufficient to send it thence throug its long and tortuous channels of circulation.

Thus, this ring, or band, or belt of clouds, is stretched around our planet to regulate the quantity of precipitation in the rain belt beneath it; to preserve the due quantum of heat on the face of the Earth; to adjust the winds; and send out for distribution to the four corners, vapors in proper quantities to make up to each river basin, climate and season its due quota of sunshine, cloud and moisture. Like the balance-whee of a well constructed chronometer, this cloud-ring affords the grand atmospherical machine the most exquisitely arranged *self-compensation.* If the Sun fail in his supply of heat to this region, more of its vapors are condensed, and heat is discharged from its latent store-houses in quantities just sufficient to keep the machine in the most perfect compensation. If on the other hand, too much heat be found to accompany the rays of the Sun as they impinge upon the upper circumference of this belt, then again on that side are the means of self-

compensation ready at hand:—so much of the cloud surface as may be requisite is then resolved into invisible vapor, in the vessels whereof surplus heat from the Sun is stored away and held in the latent state until it is called for; when instantly it is set free and becomes a visible and active agent in the grand design.

That the thermometer stands lower beneath this cloud belt than it does on either side of it, has not been shewn, or if shewn, it has not yet been made to appear by actual observation, so far as my researches are concerned; for the observations in my possession have not yet been discussed concerning the temperature of the air. But that the temperature of the air at the surface under this cloud-ring is lower, is a theoretical deduction as susceptible of demonstration as is the rotation of the Earth on its axis. It is a well known fact. Indeed nature herself has hung a thermometer under this cloud belt that is more perfect than any that man can construct, and its indications are not to be mistaken.

Where do the vapors which form this cloud-ring and which are here condensed and poured down into the sea as rain, come from? They come from the trade wind regions; under the cloud-ring they rise up; as they rise up, they expand; and as they expand, they grow cool; moreover, it requires no mercurial instrument of human device, to satisfy us that the air which brings the vapor for these clouds, cannot take it up and let it down at the same temperature. Precipitation and evaporation are the converse of each other; and the same air cannot precipitate and evaporate, take up and let down water at one and the same temperature. As the temperature of the air is raised, its capacity for receiving and retaining water in the state of vapor is increased;—as the temperature of the air is lessened, its capacity for retaining that moisture is diminished. These are physical laws; and therefore when we see water dripping down from the atmosphere, we need no instrument to tell us that the elasticity of the vapor so condensed, and falling in drops, is less than was its elasticity when it was taken up from the surface of the ocean as water, and went up into the clouds as vapor.

Hence we infer, that when the vapors of sea water are condensed, the heat which was necessary to sustain them in the vapor state, and which was borrowed from the ocean, is parted with; and that, therefore, they were subjected in the act of condensation to a lower temperature than they were in the act of evaporation. This is what is going on: ceaseless precipitation, under this cloud-ring. Evaporation under it is suspended almost entirely the year round. It is formed by the meeting of the N. E. and S. E. trade winds. The vapor and the air which they bring with them, here ascend; as they ascend they expend; as they expend their temperature falls. Hence we have, first a cloud and then precipitation. We know that the trade winds encircle the earth; that they blow perpetually; that they come from the North and the South, and meet each other near the equator; therefore that this line of meeting extends around the world; that in it, the air which the trade winds bring ascends; and that in this ascent clouds are formed. By the rainy seasons of the Torrid Zone we can trace this cloud-ring stretched like a girdle round about the earth.

In view of these facts, and of these laws, it is useless to consult the thermometer, merely to learn whether the amosphere under this cloud-ring be warmer or cooler than that on either side of it. Our knowledge of the laws of nature tells us that it is cooler.

In like manner, nature has placed a thermometer on the surface of the land, and of the water, which tells us

that the mean temperature of the top of the earth's crust, whether it be land or water, is higher than the mean temperature of the superincumbent air; and so far as the researches connected with these charts have gone, and bear upon the subject, they indicate that it is so. Philosophers had already pointed to it as a probability, and suggested it as a truth.

Where the atmosphere meets the land and water, there is the greatest amount of heat on the Earth's surface. At this place of meeting, the thermometer in every latitude attains its maximum. If we descend below this place into the ocean, or rise above it into the air, the mercury in the thermometer is observed to fall.

The heating rays of the Sun, as they pass through the atmosphere, impart little or none of their warmth to it. They must first strike the earth itself; the caloric is then absorbed or reflected by the solid and fluid parts of its crust, and given to the air. The land and the water receive the heat from the Sun, and impart it to the atmosphere:—more subtle than they, it is also more mobile and expansible. The moment that that stratum or layer of the atmospherical coating which envelopes the Earth, and which happens to be nearest to its crust, receives from it the least accession of heat, that moment it expands, becomes lighter, and flies off with it to the azure vault above. It thus gives place to a cooler layer, which in turn receives from the surface-crust fresh supplies of heat like the other, and conveys it away to the clouds. Thus, while the Sun is heating both the land and the water, the atmosphere is receiving heat from them. The sun heats them: and they, the air. But the land and the sea do not give to the atmosphere all the heat they receive from the Sun. They radiate off into space a considerable portion of it. Hence we are entitled to infer, that the mean temperature of the upper stratum of earth and water, generally, is higher than the mean temperature of the lower stratum of the air.

For particular localities and seasons there may be exceptions to this rule, as during the long nights of the polar winter, when that portion of the Earth receives no heat from the Sun's rays, and radiates profusely.

The Ferro Islands, and places similarly situated, may also form exceptions to the rule. These islands are surrounded by the warm waters of the Gulf Stream, and though standing in latitude 62° N., the ponds there are said to remain unfrozen all the winter. These islands probably receive more caloric by conduction from the air, than by absorption from the Sun's rays, and the air which supplies them with warmth, derives it from the waters which have been heated in the inter-tropical regions of the Atlantic.

The belt of equatorial calms and rains encircles the earth; were the clouds which overhang this belt luminous, and could they be seen by an observer from one of the planets, they would present to him an appearance not unlike the rings of Saturn do to us. Such an observer would remark that this cloud-ring of the Earth has a motion contrary to that of the axis of our planet itself—that while the Earth was revolving rapidly from West to East, he would observe the cloud-ring to go slowly, but only relatively, from East to West. As the winds which bring the cloud vapor to this region of calms rise up with it, the Earth is slipping from under it; and thus the cloud-ring, though really moving from West to East, with the Earth, goes relatively slower than the Earth, and would therefore appear to require a longer time to complete a revolution.

But unlike the rings of Saturn through the telescope, the outer surface or the upper side to us, of this cloud-ring, would appear exceedingly jagged, rough and uneven.

The rays of the Sun playing upon this peak, and then upon that, of the upper cloud surface, melt away one set of elevations, and create another set of depressions. The whole stratum is, it may be imagined, in the most turgid state; it is in continued throes when viewed from above: the heat which is liberated from below in the process of condensation, the currents of warm air ascending from the Earth, and of cool descending from the sky, all, we may well conceive, tend to keep the upper cloud surface in a perpetual state of agitation, upheaval and depression.

Imagine in such a cloud stratum an electrical discharge to take place; the report being caught up by the cloud ridges above, is passed from peak to peak, and repeated from valley to valley, until the last echo dies away in the mutterings of the distant thunder. How often do we hear the voice of the loud thunder rumbling and rolling away above the cloud surface, like the echo of artillery discharged among the hills.

Hence we perceive or infer that the clouds intercept the progress of sound as well as of light and heat through the atmosphere, and that this upper surface is often like Alpine regions.

It is by trains of reasoning like this, that we are continually reminded of the interest which attaches to the observations which the mariner is called on to make. There is no expression uttered by nature which is unworthy of our most attentive consideration; and mariners by registering in their logs the kind of lightning, whether sheet, forked or streaked; and the kind of thunder, whether rolling, muttering or sharp, may be furnishing facts which will throw much light on the features and character of the clouds in different latitudes, and seasons.

As an illustration of the value and interest attached to the observations upon "little things" so called, I extract from the Abstract Log of a very close observer who is co-operating with me in the collection of materials for these charts:—"In all my observations," writes this excellent and indefatigable seaman, in his Abstract Log kept for this office—"In all my observations on the tints of tropical flowers, I have found that yellow predominates."

No physical fact is too bald for observation; physical facts are the language of nature, and every expression uttered by her is worthy of our most attentive consideration. And the remark by this observant sailor about the predominance of yellow in tropical flowers, would, as a truism, be regarded with a high degree of interest both by the Botanist and Chemist.

More about the Red Sea Currents.

The remarks which I submitted to the American Association at its meeting in Charleston, page 55, and which, since the commencement of these investigations, have been made from time to time concerning the currents of the Red sea, were based upon the suggestions derived from studying the operations of those agents which nature employs to keep up the oceanic circulation. Those remarks were based on theoretical deduc-

tions elaborated out of the fact, that there is a surface current known to be setting through the Straits of B: mandeb into the Red sea. Other observations, I had none.

I have attempted on divers occasions to show theoretically, how the surface of the Red sea must in sequence of evaporations, be higher at the Straits of Babelmandeb than at the Isthmus of Suez; how it sents an inclined plane to the northwest; how the water in this sea, after it has supplied the demands for v: (which is fresh, not salt,) is salter, and therefore heavier than that which is just entering to meet those mands; and how therefore the heavier and salter water must escape as an under current through the Str of Babelmandeb into the open ocean.

I have within a few days past received volume IX, Transactions of the Bombay Geographical Soci from May, 1849, to August, 1850. From it, I learn that the excellent society of which it is the organ, especially included in its field of researches, "the determination of the saltness of the ocean, and of the ar and gulfs of the sea."

At p. 38 et seq., of that vol., is a paper by Dr. Buist on the "saltness of the Red sea." That paper fu sustains the position which has already been advanced during these investigations. It contains so much tl is valuable upon the subject, being for the most part the result of actual observation, that I take the liberty extracting quite freely from it.

"Mr. Morris, Chief Engineer of the Ajdaha, had some time ago taken the more certain method of filli a succession of bottles full of water all the way from Suez to Bombay, and these having been placed in t hands of Dr. Giraud, whose assistance, valuable at all times, became doubly valuable from the promptitud cheerfulness and alacrity, with which it was rendered, had found the following to be the results: they we unexpected, but there was no reason to doubt their accuracy:—

	Lat.	Long.	Sp. Gr.	Saline contents.
	°	°		1000 parts.
No. 1. Sea at Suez	—	—	1027	41.0
No. 2. Gulf of Suez	27.49	33.44	1026	40.0
No. 3. Red Sea	24.29	36.	1024	39.2
No. 4. do.	20.55	38.18	1026	40.5
No. 5 do.	20.43	40.03	1024	39.8
No. 6. do.	14.34	42.43	1024	39.9
No. 7. do.	12.39	44.45	1023	39.2

"Dr. Giraud gives the following note of the saltness of the sea, from a variety of other localities. From this it will be seen, that the Mediterranean at Marseilles is of the same saltness as the Red sea at Suez, while the Atlantic in the latitude of the Canaries is $\frac{4}{1000}$ more salt.

Baltic - - - - - - - grs. 20.0 in 1000.
Frith of Forth - - - - - - " 30.0 "
Bolougne - - - - - - - " 32.0 "

Havre	grs.	36.0	in 1000.
Bayonne	"	38.0	"
Marseilles	"	41.0	"
Atlantic, (Canaries)	"	44.0	"

"Following the sinuosities of the coast, the Red sea shore is more than 4000 miles in extent from the Straits of Babelmandeb round. Not one drop of water flows in from any of the countries on its shores, and the nearest river to the Red sea is the Nile, which approaches it at Suez to within eighty miles, but retires on the southward to four or five times this distance; so that on the average there seems to be not less than 500 miles of the African side depending on the Red sea for a supply of vapor. On the Arabian side, the arid expanse is of similarly ample dimensions; and in both cases, when a little rain does fall, at the interval of years, it is nearly saturated with salt before it reaches the sea. The temperature of the air betwixt Suez and Aden, often rises to 90°, and probably averages little less than 75° day and night, all the year round. The surface of the sea varies in heat from 65° to 85°, and the difference betwixt the wet and dry bulb thermometers often amount to 25°—in the kamsin or desert winds, to from 30° to 40°; the average evaporation at Aden is about eight feet for the year, though the air on the Arabian promontory is, from April to August, nearly as damp as at Bombay during the open periods of the monsoons.

"Assuming the evaporation of the Red sea to be no greater than that of Aden, a sheet of water eight feet thick, equal in area to the whole expanse of the sea, will be carried off annually in vapor; or assuming the Red sea to be 800 feet in depth at an average—and this most assuredly is more than double the fact—the whole of it would be dried up were no water to enter from the ocean, in 100 years. The waters of the Red sea, throughout, contains some four per cent. of salt by weight—or as salt is a half heavier than water, some 2.7 per cent. in bulk—or, in round numbers, say three per cent. In the course of three thousand years, on the assumptions just made, the Red sea ought to have been one mass of solid salt."

The annual evaporation at Aden in the Red sea is quoted by Dr. Buist at 8 feet. According to the observations of Mr. Laidley, quoted in the same valuable transactions, the annual evaporation at Calcutta is 15 feet. Between the Cape and Calcutta it amounts to 3 feet 9 inches for October and November; and in the Bay of Bengal it was found to exceed an inch a day, or at the rate of 30 feet and upwards the year. At Bombay it is 72 inches.

Dr. Buist also tells us that the dew point of the winds which blow over the Red sea is frequently not less than 30 or 40 degrees below the temperature of its water.

The evaporation, therefore, which goes on night and day, and all the year, from its waters near Suez, is probably much more than 8 feet the year. It is probably not less than 18 feet; and if, therefore, it took the waters which enter that sea through the Straits of Babelmandeb a year to flow up to the Isthmus of Suez, it is evident that the level of this sea at the isthmus would be 18 feet below its level at the straits; for by the supposition, 18 feet have been taken up into the clouds by evaporation from the surface, and borne away by the winds. And now if we suppose merely for the convenience of illustration, the waters to be 36 feet

deep at the straits, the bottom of the sea to be a perfect level thence to Suez, it would require no lead ai nor chemist to tell us that the depth of the Red sea at its head was just 18 feet, and that the water he just twice as much salt in it as the water at the strait has. Now the water at the straits could not balan brine. The brine is the heavier, and out it must flow as an under current, as exemplified by the illustr with regard to the water and oil in a trough, p. 56.

It probably does not take the water more than 60 days on the average to reach the head of the Re after first entering it. In that case, the annual evaporation being 18 feet, the difference of level would feet, and this estimate is probably not far wrong.

Thus the conditions with regard to the Red sea, viz: higher level, and an under current at the Stra Babelmandeb, are theoretically established with just as much certainty as we might expect to find salt bottom of it, were the mouth to be closed and all the water now in it to be evaporated.

With regard to the under current from the Mediterranean, and which under current is caused by si agencies, an early idea as to its existence was owing to the following circumstances, as given in a paper the currents at the straits mouth," by Captain ———, communicated by Dr. Hudson to the Philosopl Society, 1724.

"It is very remarkable," continues that remarkable paper, "that in the year 1712, Mons. du L'Aigle, fortunate and generous commander of the privateer called the Phœnix of Marseilles, giving chase near C Point to a Dutch ship bound to Holland, he came up with her in the middle of the gut between Tariffa Tangier, and there gave her one broadside which directly sank her, all her men being saved by Mons. L'Aigle; and a few days after, the Dutch ship with her cargo of brandy and oil, arose on the shore Tangier, which is at least 4 leagues to the westward of the place where she sunk, and directly against strength of the current; which has persuaded many men, that there is a recurrency in the deep water in middle of the gut that sets outward to the grand ocean, which this accident very much demonstrates; possibly a great part of the water which runs into the straits returns that way, and along the two coasts bef mentioned: otherwise this ship must of course have been driven towards Cueta, and so upwards. The wa in the gut must be very deep; several of the commanders of our ships of war having attempted to sound with the longest lines they could contrive, but could never find any bottom."

In 1828, Dr. Wollaston, in a paper before the Philosophical Society, stated that he found the speci gravity of a specimen of sea water from a depth of 670 fathoms, 50 miles within the straits, to have a "dens exceeding that of distilled water by more than 4 times the usual excess, and accordingly leaves, upon evap ration, more than 4 times the usual quantity of saline residuum. Hence it is clear, that an under current ou ward of such denser water, if of equal breadth and depth with the current inward near the surface, wou carry out as much salt below as is brought in above, although it moved with less than one-fourth part of tl velocity, and would thus prevent a perpetual increase of saltness in the Mediterranean sea, beyond that exis ing in the Atlantic."

The Doctor obtained this specimen of sea water from a captain in the English navy, who had collecte

it for Doctor Marcet. Dr. Marcet died before receiving it, and it had remained in the captain's hands some time before it came into those of Wollaston.

It may therefore have lost something by evaporation, for it is difficult to conceive that all the river water and three-fourths of the sea water which runs into the Mediterranean is evaporated from it, leaving a brine for the under current, having four times as much salt as the water at the surface of the sea usually contains. Very recently, M. Coupvent des Bois, has shown by actual observation, the existence of an outer and under current from the Mediterranean.

These facts, and the statements of the Secretary of the Geographical Society of Bombay, seem to leave no room to doubt as to the existence of an under current from the Red sea, and as to the cause of the surface current which flows into it. I think it a matter of demonstration.

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*On the Geological Agency of the Winds.**

Nature is a whole, and all the departments thereof are intimately connected. If we attempt to study in one of them, we find ourselves tracing clues which lead us off insensibly into others, and, before we are aware, we discover ourselves exploring the chambers of some other department.

The study of drift takes the geologist out to sea, and reminds him that a knowledge of waves, winds and currents, of navigation and hydrography, are closely and intimately connected with his favorite pursuit.

The astronomer directs his telescope to the most remote star, or to the nearest planet in the sky, and makes an observation upon it. He cannot reduce this observation, nor make any use of it, until he has availed himself of certain principles of optics; until he has consulted the thermometer, gauged the atmosphere, and considered the effect of heat in changing its powers of refraction. In order to adjust the pendulum of his clock to the right length, he has to measure the water of the sea and weigh the Earth: he too must therefore go into the study of the tides; he must examine the Earth's crust, and consider the matter of which it is composed from pole to pole, circumference to centre; and in doing this, he finds himself in his researches right alongside of the navigator, the geologist and the meteorologist, with a host of other good fellows, each one holding by the same thread, and following it up into the same labyrinth—all, it may be, with different objects in view, but nevertheless, where there are stores of knowledge for all, and instruction for each one in particular. And thus, in undertaking to follow the "wind in his circuits" over the ocean, I have found myself standing side by side with the geologist on the land, and with him far away from the sea shore, engaged in considering some of the phenomena which the inland basins of the Earth—those immense indentations on its surface that have no sea drainage—present for contemplation and study.

Among the most interesting of these, is that of the Dead sea. Lieutenant Lynch, U. S. Navy, has run a level from that sea to the Mediterranean, and finds the former to be about 13,00[illegible] feet below the general sea level of the Earth. In seeking to account for this great difference of water level, the geologist examines the

* Read before the American Association at its meeting in Albany, New York, Aug. 1851.

neighboring region, and calls to his aid the forces of elevation and depression which are supposed to have resided in the neighborhood: he then points to them as the agents which did the work. They are mighty agents, and they have diversified the surface of the Earth with the most towering monuments of their power. But is it necessary to suppose that they resided in the vicinity of this region? May they not have been, if not in this case, at least in the case of other inland basins, as far removed as the other hemisphere? This is a question which I do not pretend to answer definitively. But the inquiry as to the geological agency of the winds in such cases, is a question which my investigations have suggested; and I therefore present it as one which in accounting for the formation of this or that inland basin, is worthy, at least, of consideration.

Is there any evidence that the annual amount of precipitation upon the water-shed of the Dead sea, at some former period, was greater than the annual amount of evaporation from it? If yea, where did the vapor that supplied the excess of that precipitation come from, and what has cut off that supply? The mere depression of the lake bed would not do it.

If there were ever a river from the Dead sea to the arms of the ocean about it, we may imagine that river to have abounded with falls, as the rivers do which drain the North American lakes into the Atlantic. And if we establish the fact that the Dead sea did ever send a river to the ocean, we carry along with it the admission that when that sea overflowed into that river, then the water that fell from the clouds over the Dead sea basin was more than the winds could convert into vapor and carry away again; the river carried off the excess to the ocean.

In the basin of the Dead sea, in the basin of the Caspian, of the sea of Aral, and in the other inland basins of Asia, we are entitled to infer that the precipitation and evaporation are at this time exactly equal. Were it not so, the level of these seas would be rising or sinking. If the precipitation were in excess, these seas would be gradually becoming fuller; and if the evaporation were in excess, they would be gradually drying up; but observation does not show, nor history tell us, that either is the case. As far as we know, the level of these seas is as permanent as that of the ocean, and it is difficult to realize the existence of subterranean channels between it and the great ocean. Were there such a channel, the Dead sea being the lower, it would be the recipient of ocean waters; and we cannot conceive how it should be such a recipient, without ultimately rising to the level of its feeder.

It may perhaps be evident that the question suggested by my researches has no bearing upon the Dead sea; that local elevations and subsidences alone were concerned in placing the level of its waters where it is. But is it probable that, throughout all the geological periods, during all the changes which have taken place in the distribution of land and water surface over the earth, the winds, which in the general channels of circulation pass over the Dead sea, have alone been unchanged? Throughout all ages, periods and formations, is it probable that the winds have just brought as much moisture to that sea as they now bring, and have just taken up as much water from it as they now carry off? It is possible. But because the agency of the winds may have had nothing to do in placing the level of the Dead sea where it is, does it therefore follow that the consideration of this question would be irrelevant in the attempt to account for the level of the water reservoir of other inland basins?

Where does the water, which falls from the clouds upon the valley of the great North American lakes, come from? It goes into the sea, and out of the sea it must come again; else "the sea would be full;" for "all the rivers run into the sea." From what part of the sea, therefore, do the clouds get vapor to make rain of for the lake country.

My researches with regard to the winds, have suggested the probability that the vapor which is condensed into rains for the Lake valley, and which the St. Lawrence carries off to the Atlantic ocean, is evaporated by the S. E. trade winds of the Pacific ocean. Suppose this to be the case, and that the winds which bring this vapor, arrive with it in the lake country at a mean dew point of 50°. This would make the S. W. winds the rain winds for the lakes generally, as well as for the Mississippi valley: they are also, speaking generally, the rain winds of Europe, and, I have no doubt, of extra-tropical Asia also.

Suppose a certain mountain-range, thousands of miles to the S. W. of the lakes, but across the path of these winds, were to be suddenly elevated, and its crest pushed up into the regions of snow, having a mean temperature of 30° Fahr. The winds, in passing that range, would be subjected to a dew doint of 30°; and not meeting with any more evaporating surface between such range and the lakes, they would have no longer any moisture to deposit at the supposed lake temperature of 50°: they could not yield the dew point to anything above 30°. Consequently the amount of precipitation in the lake country would fall off; the winds which feed the lakes would cease to bring as much water as the lakes now give to the St. Lawrence; that river, and the Niagara, would drain them to the level of their bed: evaporation would be increased, by reason of the dryness of the atmosphere and the want of rain; and the lakes would sink to that level, at which, as in the case of the Caspian sea, the precipitation and evaporation would finally become equal. Thus our great lakes would remain inland seas at a permanent level; the salt brought from the soil, by the washings of the rivers and rains, would cease to be taken off to the ocean as it now is; and finally, too, the Great Lakes, in the process of ages, would become first brackish, and then briny. Now suppose the water basins which hold the lakes to be over a thousand fathoms, (6,000 feet) deep. We know they are not nearly so deep; but suppose them to be 6,000 feet deep. The process of evaporation, after the St. Lawrence had gone dry, might go on until one or two thousand feet or more were lost from the surface; and we should then have another instance of the level of an inland water basin being far below the sea level, as in the case of the Dead sea; or it would become a rainless district, when the lakes themselves would go dry.

Corallines are at work about the Gulf stream; they have built up the Florida reefs on one side, and the Bahama banks on the other. Suppose they should build up a dam across that pass, and obstruct the Gulf stream; and that in like manner they were to connect Cuba with Yucatan, by damming up the Yucatan pass, so that the waters of the Atlantic should cease to flow into the Gulf. What should we have?

The depth of the marine basin which holds the waters of the Gulf, is in the deepest part, about a mile and a half. The officers of the U. S. Ship Albany have run a line of deep sea-soundings from west to east across the Gulf; the greatest depth they obtained was about 8,000 feet.

We should therefore have, by stopping up the channels between the Gulf and the Atlantic, not a sea level

in the Gulf, but we should have a mean level between evaporation and precipitation. If the former wer excess, the level of the Gulf waters would sink down until the surface exposed to the air would be just s cient to return to the atmosphere, as vapor, the amount of water discharged by the rivers, the Mississippi others, into the Gulf. As the waters were lowered, the extent of evaporating surface would grow less and l until nature should establish the proper ratio between the ability of the air to take up, and the capacity of rain to let down. Thus we might have a sea whose level would be much further below the water level of ocean, than is the Dead sea.

There is still another process besides the two already alluded to, by which the drainage of these inla basins may, through the agency of the winds, have been cut off from the great salt seas; and that is by elevation of continents from the bottom of the sea in distant regions of the earth, and the substitution cau thereby of a dry land for a water surface as the source of vapor supply to the winds that blow over the pla

From what part of the ocean, I again ask, comes the vapor that forms the rains that fall on that immei water-shed to which the American lakes give drainage? My investigations have suggested the idea that they co from the trade-wind region of the South Pacific ocean. Certain it is, that they must come from the s and not from the land; for in this view, I do not consider that the rain which falls to-day, and is taken straightway into the clouds to be precipitated again to-morrow; but I consider the excess of the precipitation ov the evaporation, which, in this case, is the volume of water discharged by the St. Lawrence into the sea; th is the amount of water which has to be taken up from the sea again, carried back through the air to the La country, and precipitated upon it. And I therefore repeat the question: Where, from what portion of the oce was the water which is discharged by the St. Lawrence taken up into the air? It must be taken up fro some portions where the evaporation is greater than the precipitation; and that is only in the trade-wind regior and it must also be taken up where the mean temperature, or at any rate, where the mean dew point is high than it is in the Lake country; for after moisture gets into the atmosphere, it is only by lowering the dew-poir that we can get it out again.

Now suppose that a continent should rise up in that part of the ocean, wherever it may be, that suppli the clouds with the vapor that makes the rain for this Lake water shed; What would be the result? Wh surely a change of climate in the lake country; an increase of evaporation from it, because a decrease of pr cipitation upon it, and consequently a diminution of cloudy screens to protect the waters of the lakes fro being sucked up by the rays of the Sun; and consequently, too, there would follow a low stage for wate courses; and a lowering of the lake level would ensue.

So far, I have used the lakes only hypothetically, that I might the better illustrate the bearings of th question with which I set out, viz: Where have the subsidences and the elevations taken place, that hav made an inland basin here, and another there? Is the seat of this action near by, or far off; and what hav the winds had to do in cutting off the sea drainage of inland water-sheds?

But in this hypothetical case, with regard to the hydrographical basins of the Gulf and Lakes, I have confine myself strictly to analogies. Mountain ranges have been upheaved across the course of the winds, and continent

have been raised from the bottom of the sea: and, no doubt, the influence of such upheavals has been felt in remote regions by means of the winds, and the effects which a greater or less amount of moisture brought by them would produce.

In the case of the Salt lake of Utah, we have an example of drainage that has been cut off, and an illustration of the process by which nature equalizes the evaporation and precipitation. To do this, in this instance, she is salting up the basin which received the drainage of this inland water-shed. Here we have the appearance, I am told, of an old channel by which the water used to flow from this basin to the sea. Supposing there was such a time and such a water course, the water returned through it to the ocean was the amount by which the precipitation used to exceed the evaporation over the whole extent of country drained through this, now dry, bed of a river. The winds have had something probably to do with this: they are the agents which used to bring more moisture to this water-shed than they took away; and they are the agents which now carry off from that valley, more moisture than is brought to it, and which therefore are making a salt bed of places that used to be covered by water. In like manner there is evidence that the Great American Lakes formerly had a drainage with the Gulf of Mexico. Steamers have been actually known, in former years and in times of freshets, to pass from the Mississippi over into the lakes. At low water the bed of a dry river can be traced between them. Now the Salt lake of Utah is to the southward and westward of our northern lake basin; that is the quarter whence the rain winds have been supposed to come. May not the same cause which lessened the precipitation or increased the evaporation in the Salt lake water-shed, have done the same for the water-shed of the Great American system of lakes?

If the mountains to the West, the Sierra Nevada, stand higher now than they formerly did, and if the winds which fed the Salt lake valley with precipitation had, as I suppose they have, to pass the summits of the mountains, it is easy to perceive why the winds should not convey as much vapor across them now, as they did when the summit of the ranges was lower and not so cool.

The Andes, in the trade wind region of South America, stand up so high that the wind, in order to cross them, has to part with all its moisture; and consequently there is, on the other side, a rainless region. Now suppose a range of such mountains as these to be elevated across the track of the winds which supply the Lake country with rains: it is easy to perceive how the whole country watered by the vapor which such winds bring, would be converted into a rainless region.

I have used these hypothetical cases to illustrate a position which any philosopher, who considers the geological agency of the winds, may with propriety consult, when he is told of an inland basin, the water level of which it is evident was once higher than it now is; and that position is, that though the evidences of a higher water level be unmistakeable and conclusive, it does not follow, therefore, that there has been a subsidence of the lake basin itself, or an upheaval of the water-shed drained by it.

The cause which has produced this change of water level, instead of being local and near, may be remote: it may have its seat in the obstructions which have been interposed in some other quarter of the world; which obstructions may prevent the winds from taking up, or from bearing off, their wanted supplies of moisture for the region whose water level has been lowered.

I am not prepared to maintain that the water-level of our great system of lakes has been changed by any suc process; though I do not think it improbable. Nor am I prepared to ascribe the change in the Salt lake of Uta *wholly* to obstructions, near or remote, which have prevented the winds from bringing as many and as copiou rain-clouds as they at some remote period were want to bring to this valley; though in this case it appeai obvious that the precipitation has diminished, and the evaporation has increased; and it is not easily perceive how a mere subsidence of the Lake basin would change the rate of evaporation, or alter the amount of pre cipitation there.

Having, therefore, I hope, made clear the meaning of the question proposed, by showing the manner i which winds may become important geological agents; and having explained how the upheaving of a mountai range in one part of the world may, through the winds, affect climates and produced geological phenomena i another, I return to the Dead sea, and the great inland basins of Asia, and ask how far is it possible for th elevation of the South American continent, and the upheaval of its mountains, to have had any effect upon th water-level of those seas? There are indications that they all once had a higher water-level than they nov have; and that formerly the amount of precipitation was greater than it now is: then what has become of th sources of vapor? What has diminished its supply? Its supply would be diminished by the substitutioi of dry land, in those parts of the ocean which used to supply that vapor; or the quantity of vapor deposite in the hydrographical basins of those seas, would have been lessened if a snow-capped range of mountains ha been elevated across the path of these winds and between the places where they were supplied with vapor and these basins.

A chain of evidence, which it would be difficult to set aside, can be introduced, if required, to show tha the vapor which supplies the extra-tropical regions of the North with rains, comes, in all probability, from th trade-wind regions of the southern hemisphere.

The prevailing winds of the Temperate Zones blow towards the poles: they are going from warmer t colder climates. Consequently their capacity for moisture increases with their temperature; and they must precipitate, on their way from warmer to colder regions, more water than they can take up again.

The prevailing winds of the Torrid Zone blow towards the equator: they are going from colder to warmei climates. Their capacity for moisture is therefore on the increase; and they therefore must evaporate, from this zone, more water than they precipitate upon it again.

All the great rivers lie in the northern hemisphere. With more land and less water, its total amount o precipitation is nevertheless greater, than that of the southern hemisphere.

The evaporating surface of sea water, exposed to the action of the southeast trade winds exceeds, severa times in extent, that upon which the northeast trade winds are known to play. These southeast trade winds when they arrive at the belt of equatorial calms, charged with vapor from the sea, should, when they rise up and come over into this hemisphere, take, in consequence of the Earth's diurnal motion, a direction to th northeast. This is the direction which the rains of the Mississippi valley indicate, and which the microscope of Ehrenberg has proved that the southeast trade winds do take; for in a northeasterly direction from the great

river basins of equatorial America, and in the vicinity of the Cape de Verd islands; at Lyons and Genoa; in Malta and the Tyrol; showers of the so-called sirocco dust are known to occur. That celebrated microscopist has examined, with the utmost care, specimens of this dust; and in every specimen that has come to his notice during the period of sixteen years, he has recognised the same organisms, the same forms in them all; and he traces the *locus* of the great majority of them to the trade wind regions of South America.

Now, if it be true that the trade winds from that part of the world take up there the water which is to be rained in the extra-tropical North, the path ascribed to the southeast trades of Africa and America, after they descend and become the prevailing southwest winds of the northern hemisphere, should pass over a region of less percipitation, generally, than they would do, if, while performing the office of southeast trades, they had blown over water instead of land. The southeast trade winds, with their load of vapor, whether great or small, take, after ascending in the equatorial calms, a northeastly direction: they continue to flow in the upper regions of the air, in that direction, until they cross the tropic of Cancer. The places of least rain, then, between this tropic and the pole, should be precisely those places which depend for their rains upon the vapor which the winds that blow over southeast trade wind Africa and America convey.

Now, if we could trace the path of these winds through the extra-tropical regions of the northern hemisphere, we should be able to identify it by the footprints of the clouds; for the path of the winds which depend for their moisture upon such sources of supply as the dry land of Central South America and Africa, cannot lie through a country that is watered well.

It is a remarkable coincidence, at least, that the countries in the extra-tropical regions of the North, that are situated to the northeast of the southeast trade winds of South Africa and America; that the countries with us, over which theory makes these winds to blow, include all the great deserts of Asia, and the districts of least precipitation in Europe.*

The hyetographic map of Europe, in Johnston's beautiful Physical Atlas, places the region of least precipitation between these two lines. See Plate IV.

It would seem that nature, as if to reclaim this "lee" land from the desert, had stationed by the wayside of these winds a succession of inland seas to serve them as relays, for supplying with moisture this thirsty air. There is the Mediterranean sea, the Caspian sea, and the sea of Aral, all of which are situated exactly in this direction; as though these sheets of water were designed, in the grand system of aqueous

* Let any one take a map of Mercator's projection, and on it draw lines from the tropic of Cancer towards the North, to represent the probable route and direction which the trade winds of the two southern continents take, in their general channels of circulation over the northern continents. The country between these two lines is the country which, in the general system of atmospherical circulation, lies under the lee of southeast trade wind Africa and America. And to see where this country is, we have first to ascertain where those two points on the equator are, between which the southeast trade winds cross, after having traversed the greatest extent of land surface in South America; and then from these point to project lines in the direction which these winds are supposed to take, after rising up in the equatorial calms. These two points will be, one near the mouth of the Amazon, the other not far from the Gallapagos islands: the part of the equator between them is the part crossed by the southeast trades, after having traversed the greatest extent of land from whose surface the supplies of moisture are most scanty. A line from the Gallapagos through Florence in Italy, another from the mouth of the Amazon through Aleppo in Holy Land, (Plate IV) would, after passing the tropic of Cancer, mark upon the surface of the earth the route of these winds: this is that "lee country," which, if such be the system of atmospherical circulation, ought to be scantily supplied with rains.

arrangements, to supply with fresh vapor, winds that had already left rain enough behind them to mak Amazon and an Orinoco of.

The Andes were once covered by the sea; for their tops are now crowned with the remains of m animals. When they and their continent were submerged—admitting that Europe in general outline was as it now is—it cannot be supposed, if the circulation of vapor were then such as it is supposed now tc that the climates of that part of the old world which is under the lee of those mountains, were then as sca supplied with moisture as they now are. When the sea covered South America, the winds had nearly al waters, which now make the Amazon, to bring away with them, and to distribute among the countries situ along the route ascribed to them.

Is there any evidence that the basin which holds the Caspian sea has been more copiously watered it is now? There is evidence in favor of the probability that it has been; for portions of that sea have reti and left salt beds behind.

If ever the Caspian sea exposed a larger surface for evaporation than it now does; if the precipita in that valley ever exceeded the evaporation from it, as it does in all valleys drained into the open sea; t there must have been a change of hygrometrical condition there. And admitting the vapor-springs for valley to be situated in the direction supposed, the rising up of a continent from the bottom of the sea, or upheaval of a range of mountains in certain parts of America, Africa or Spain, across the route of the wi which brought the rain for Caspian water-shed, might have been sufficient to rob them of the moisture wh they were wont to carry away and precipitate upon this great inland basin. See how the Andes have m Atacama a desert, and of Western Peru a rainless country; these regions have been made rainless sim by the rising up of a mountain range between them and the vapor-springs in the ocean which feed v moisture the winds that blow over these now rainless regions.

That part of Asia, then, which is under the lee of southern trade wind Africa, lies to the north of tropic of Cancer, and between two lines, the one passing through Cape Palmas and Medina, the other throu Aden and Delhi. Being extended to the equator, they will include that part of it which is crossed by continental southeast trade winds of Africa, after they have traversed the greatest extent of land surfa (Plate IV.)

The range which lies between the two lines that represent the course of the American winds with th vapors, and the two lines which represent the course of the African winds with their vapors, is the rar which is under the lee of winds that have for the most part traversed water surface, or the ocean, in th circuit as southeast trade winds. But a bare inspection of Plate IV, will show that the southeast trade wi which cross the equator between long. 15° and 50° W., and which are supposed to blow over into t hemisphere between these two ranges, have traversed land as well as water; and the Trade Wind Ch shews that it is precisely those winds, which in the summer and fall are converted into southwest monsoc for supplying the whole extent of Guinea with rains to make rivers of. Those winds, therefore, it wo seem, leave much of their moisture behind them, and pass along to their channels in the grand system circulation, for the most part as dry winds. Moreover, it is not to be supposed that the channels throu

which the winds that cross the equator at the several places named, are as sharply defined in nature as the lines suggested, or as Plate IV would represent them to do.

The whole region of the extra-tropical old world, that is included within the ranges marked, is the region which has most land to windward of it in the southern hemisphere. Now it is a curious *coincidence* at least, that all the great extra-tropical deserts of the Earth, with those regions in Europe and Asia which have the least amount of precipitation upon them should lie within this range. That they are situated under the lee of the southern continents, and have but little rain, may be a coincidence, I admit; but that these deserts of the old world are placed where they are, is no coincidence, no accident: they are placed where they are, and as they are, by design; and in being so placed, it was intended that they should subserve some grand purpose in the terrestrial economy. Let us see, therefore, if we can discover any marks of that design—any of the purposes of such an arrangement—and trace any connection between that arrangement and the supposition which I maintain, as to the place where the winds that blow over those regions derive their vapors.

It will be remarked at once that all the inland seas of Asia, and all those of Europe, except the semi-freshwater gulfs of the North, are within this range. The Persian Gulf and the Red sea, the Mediterranean, the Black and the Caspian, all fall within it. And why are they planted there? Why are they arranged to the northeast and southwest under this lee, and in the very direction in which theory makes this breadth of thirsty winds to prevail? Clearly and obviously, one of the purposes in the Divine economy was, that they might replenish with vapor the winds which are almost vaporless when they arrive at these regions in the general system of circulation. And why should these winds be almost vaporless? They are almost vaporless, because their route in the general system of circulation is such, that they are not brought into contact with a water surface from which the needful supplies of vapor are to be had; or being obtained, the supplies have since been taken away by the cool tops of mountain ranges over which these winds have had to pass.

In the Mediterranean, the evaporation is greater than the precipitation. Upon the Red Sea there never falls a drop of rain; it is all evaporation. Are we not therefore entitled to regard the Red sea as a make-weight thrown in to regulate the proportion of cloud and sunshine, and to dispense rain to certain parts of the Earth in due season and in proper quantities? Have we not, in these two facts, evidence conclusive, that the winds which blow over these two seas, come, for the most part, from a dry country, from regions which contain few or no pools to furnish supplies of vapor?

Indeed, so scantily supplied with vapor are the winds which pass in the general channels of circulation over the water-shed and sea-basin of the Mediterranean, that they take up there more water as vapor than they deposit. But throwing out of the question what is taken up from the surface of the Mediterranean itself, these winds deposit more water on the water-shed whose drainage leads into that sea, than they take up from it again. The excess is to be found in the rivers which discharge into the Mediterranean; but so thirsty are the winds which blow across the bosom of that sea, that they not only take up again all the water that thoses rivers pour into it, but they are supposed by philosophers to create a demand for an immense current from the Atlantic to supply the waste.

It is estimated that three* times as much water as the Mediterranean receives from its rivers, is evap from its surface. This may be an over-estimate; but the fact that the evaporation from it is in excess precipitation, is made obvious by the current which the Atlantic sends into it through the Straits of Gib and the difference, we may rest assured, whether it be much or little, is carried off to modify climate elsew to refresh with showers, and make fruitful, some other part of the earth.

The great inland basin of Asia, in which are Aral and the Caspian seas, is situated on the route wh this hypothesis I have made these thirsty winds from southeast trade-wind Africa and America to take so scant of vapor are these winds when they arrive in this basin, that they have no moisture to leave bel just as much as they pour down, they take up again and carry off. The level of the Caspian sea is as perm as that of the whole ocean. We know that the volume of water returned by the rivers, the rains, an dews, into the whole ocean, is exactly equal to the volume which the whole ocean gives back to the atmosp as far as our knowledge extends, the level of each of these two seas is as permanent as that of the great c itself. Therefore the volume of water discharged by rivers, the rains and the dews into these two seas is ex equal to the volume which these two seas give back as vapor to the atmosphere.

These winds, therefore, do not begin permanently to lay down their load of moisture, be it great or s until they cross the Oural mountains. On the steppes of Issam, after they have supplied the Amazon anc other great equatorial rivers of the South, we find them first beginning to lay down more moisture than take up again. In the Obi, the Yenesi and the Lena, is to be found the volume which contains the expressio the load of water which these winds have brought from the southern hemisphere, from the Mediterranean anc Red sea; for in these almost hyperborean river basins do we find the first instance in which, throughout the e range assigned these winds, they have, after supplying the Amazon, &c., left more water behind them t they have taken up again and carried off. The low temperatures of Siberian Asia are quite sufficient to ext from these winds, the remnants of vapor which the cool mountain tops and mighty rivers of the south hemisphere have left in them.

Here I may be permitted to pause, that I may call attention to the remarkable coincidence, admire the marks of design, the beautiful and exquisite adjustments that we see here provided, to ensure perfect workings of the great atmospherical machine. This coincidence—may I not call it cause and effect?- between the hygrometrical conditions of all the countries within, and the hygrometrical conditions of the countries without, the range included within the lines which I have drawn (Plate IV) to represent the ro in this hemisphere, of the southeast trade winds *after* they have blown their course over the land in South Afr and America. Both to the right and left of this range, are countries included between the same parall in which it is; yet these countries all receive more water from the atmosphere, than they give back to again; they all have rivers running into the sea. On the one hand, there is in Europe, the Rhine, the Ell and all the great rivers that empty into the Atlantic: on the other hand, there are in Asia, the Ganges, a

* *Vide* Article "Physical Geography," Encyclopædia Britannica.

all the great rivers of China; and in North America, in the latitude of the Caspian sea, is our great system of fresh water lakes: all of these receive from the atmosphere immense volumes of water, and pour it back into the sea in streams the most magnificent.

It is remarkable that none of these copiously supplied water-sheds have, to the southwest of them in the trade wind regions of the southern hemisphere, any considerable body of land: they are, all of them, under the lee of evaporating surfaces, of ocean waters in the trade wind regions of the South. Only those countries in the extra-tropical North, which I have described as lying under the lee of trade wind South America and Africa, are scantily supplied with rains. Pray examine Plate IV in this connection.

The surface of the Caspian sea is about equal to that of our lakes: in it evaporation is just equal to the precipitation. Our lakes are between the same parallels, and about the same distance from the western coast of America that the Caspian is from the western coast of Europe: and yet the waters discharged by the St. Lawrence give us an idea of how greatly the precipitation upon it is in excess of the evaporation. To windward of the lakes, and in the trade wind regions of the southern hemisphere, is no land; but to windward of the Caspian sea and in the trade wind region of the southern hemisphere, there is land. Therefore, supposing the course of the vapor-distributing winds to be such as I maintain it to be, ought they not to carry more water from the ocean to the American lakes, than it is possible for them to carry from the land—from the interior of South Africa and America—to the valley of the Caspian sea?

In like manner extra-tropical New Holland and South Africa have each land—not water—to the windward of them in the trade wind regions of the northern hemisphere, where, according to this hypothesis, the vapor for their rains ought to be taken up: they are both countries of little rain; but extra-tropical South America has, in the trade wind region to windward of it in the northern hemisphere, a great extent of ocean, and the amount of precipitation in extra-tropical South America is wonderful. The coincidence, therefore, is remarkable, that the countries in the extra-tropical regions of this hemisphere, which lie to the northeast of large districts of land in the trade wind regions of the other hemisphere, should be scantily supplied with rains; and likewise that those so situated in the extra-tropical South, with regard to land in the trade wind region of the North, should be scantily supplied with rains.

Having thus remarked upon the coincidence, let us turn to the evidences of design, and contemplate the beautiful harmony displayed in the arrangement of the land and water, as we find them along this conjectural "wind-road." Plate IV.

Those who admit design among terrestrial adaptations, or have studied the economy of cosmical arrangements, will not be loth to grant that by design the atmosphere keeps in circulation a certain amount of moisture; that the waters of which this moisture is made are supplied by the aqueous surface of the earth, and that it is to be returned to the seas again through rivers and the process of precipitation; that a permanent increase or decrease of the quantity of water thus put and kept in circulation by the winds would be followed by a corresponding change of hygrometrical conditions, which would draw after it permanent changes of climate; and that permanent changes of climate would involve the ultimate well-being of myriads of organisms, both in the vegetable and animal kingdoms.

The quantity of moisture that the atmosphere keeps in circulation is, no doubt, just that quantity which is best suited to the well-being, and most adapted to the proper development of the vegetable and animal kingdoms; and that quantity is dependent upon the arrangement and the proportions that we see in nature between the land and the water—between mountain and desert, river and sea. If the seas and evaporating surfaces were changed, and removed from the places they occupy, to other places, the principal places of precipitation probably would also be changed: whole families of plants would wither and die for want of cloud and sunshine, dry and wet, in proper proportions and in due season; and, with the blight of plants, whole tribes of animals would also perish; under such a chance arrangement, man would no longer be able to rely upon the early and the latter rain, or to count with certainty upon the rains being sent in due season for seed time and harvest. And that the rain will be sent in due season, we are assured from on High; and when we recollect who it is that "sendeth" it, we feel the conviction strong within us, that He that sendeth the rain has the winds for his messengers; and that they may do his bidding, the land and the sea were arranged, both as to position and relative proportions, where they are, and as they are.

It should be borne in mind that the southeast trade winds, after they rise up at the equator, have to overleap the northeast trade winds. Consequently they do not touch the Earth until near the tropic of Cancer—(see the bearded arrows, Plate IV) more frequently to the north, than to the south of it; but for a part of every year, the place where these vaulting southeast trades first strike the Earth, after leaving the other hemisphere, is very near this tropic. On the equatorial side of it, be it remembered, the northeast trade winds blow; on the polar side, what was the southeast trades, and what is now the prevailing southwesterly winds of our hemisphere, prevail. Now examine Plate IV, and it will be seen that the upper half of the Red sea is north of the tropic of Cancer; the lower half, is to the south of it; that the latter is within the northeast trade wind region; the former, in the region where the southwest passage winds are the prevailing winds.

The River Tigris is probably evaporated from the upper half of this sea by these winds; while the northeast trade winds take up from the lower half, those vapors which feed the Nile with rain, and which the clouds deliver to the cold demands of the Mountains of the Moon. Thus there are two "wind-roads" crossing this sea: to the windward of it, each wind path is through a rainless region; to the leeward there is, in each case, a river to cross.

The Persian Gulf lies for the most part in the track of the southwest winds; to the windward of the Persian Gulf is a desert; to the leeward, the River Indus. This is the way in which theory would require the vapor from the Red sea and Persian Gulf to be conveyed; and this is the direction in which we find indications that it is conveyed. For to leeward do we find, in each case, a river, telling to us by signs not to be mistaken, that it receives more water from the clouds than it gives back to the winds.

Is it not a curious circumstance that the winds which travel the road suggested from the southern hemisphere, should, when they touched the Earth on the polar side of the tropic of Cancer, be so thirsty, more thirsty, much more, than those which travel on either side of their path, and which are supposed to have come from southern seas, not from southern lands?

The Mediterranean has to give those winds three times as much vapor as it receives from them; the Red sea gives them as much as they will take, and receives nothing back in return; the Persian Gulf also gives more than it receives. What becomes of the rest? Doubtless it is given to the winds, that they may bear it off to distant regions, and make lands fruitful, that but for these sources of supply would be almost rainless, if not entirely arid, waste and barren.

These seas and arms of the ocean now present themselves to the mind as counterpoises in the great hygrometrical machinery of the Earth. As sheets of water placed where they are, to balance the land in the trade-wind region of South America, and South Africa, they now present themselves. When the foundations of the Earth were laid, we know who it was that "measured the waters in the hollow of his hand, and meted out the heavens with a span, and comprehended the dust of the Earth in a measure, and weighed the mountains in scales, and the hills in a balance."

Here then we see harmony in the winds, design in the mountains, order in the sea, arrangement in the dust. Here are signs of beauty and works of grandeur; and we may now fancy, that in this exquisite system of adaptations and compensations, we can almost behold in the Red and Mediterranean seas the very waters that were held in the hollow of the Almighty hand, when He weighed the Andes and balanced the hills of Africa in His comprehensive scales.

In that great inland basin of Asia which holds the Caspian sea, and embraces an arrear of one million and a half of geographical square miles of land, we see the water surface so exquisitely adjusted, that it is just sufficient, and no more, to return to the atmosphere as vapor, exactly as much moisture as the atmosphere lends in rain to the rivers of that basin.

Thus we may regard the Mediterranean, the Red sea and Persian Gulf as relays, distributed along the route of these thirsty winds from the continents of the other hemisphere, to supply them with vapors, or to restore to them that which they have left behind to feed the sources of the Amazon, the Niger, and the Congo.

In contemplating the office of the winds in the distribution of moisture over the Earth, we may liken them to messengers that are heavily tasked, being laden with as much as they can bear. The load of water given to them to carry away from the sea into the recesses of the most distant mountains, becomes too heavy, and there it is precipitated as mountain torrents. There is then a change of temperature; the atmosphere is invigorated; and straightway the winds commence to lift up their load again; taking as before a large portion of that which they had just let down to rest. Thus:

A change occurs in the sublime economy, by which to-day the winds are relieved of their load in one part of the valley of the west; they precipitate and pass on. To-morrow fresh air arrives; and it commences straightway to take up this load again—to evaporate from leaf, twig and soil all the moisture it can find, and to bear it off to make rains for the Lake country or some other land.

The change of temperature from day to day accomplishes important ends in the grand arrangement for giving circulation to moisture and rains to the Earth. According to the beautiful series of observations,

which, at my request, a brother officer* conducted upon the habits of the Mississippi river as it passes Me in Tennessee, it appears that only about one-sixth of the water that is rained in that valley reaches the through that river. The other five-sixths are taken up again into the air, and are carried off in the g channels of circulation to supply other systems of lake and river basins. But these five-sixths come fro seas; the clouds let them down in the Mississippi valley to rest, but the winds take them up again; and s may be taken up and let down many times before they reach the sea again; for from the sea they orig came, and to the sea they are ultimately bound.

The hypothesis that the winds from South Africa and America do take the course through Europ Asia which I have marked out for them, (Plate IV,) is supported by so many coincidences, to say the that we are entitled to regard it as probably correct, until a train of coincidences as striking can be addu shew that such is not the case.

Returning once more to a consideration of the geological agency of the winds in accounting for t pression of the Dead sea, we now see the fact most strikingly brought out before us, that if the Str Gibraltar were to be barred up, so that no water could pass through them, we should have a great depres water level in the Mediterranean. Three times as much water is evaporated from that sea as is returne through the rivers. A portion of water evaporated from it is probably rained down and returned to it th the rivers; but—supposing it to be barred up—as the demand upon it for vapor would exceed the sup rains and rivers, it would commence to dry up. As it sinks down, the area exposed for evaporation decrease, and the supplies to the rivers would diminish, until finally there would be established betwe evaporation and precipitation an equilibrium, as in the Dead and Caspian seas; but for aught we kno water level of the Mediterranean might, before this equilibrium were attained, have reached a stage far that of the Dead sea level.

The Lake Tadjura is now in the act of attaining such an equilibrium: there are connected with remains of a channel by which the water ran into the sea; but the surface of the lake is now 500 feet the sea level and it is salting up. If not in the Dead sea, do we not, in the valley of this lake, find ou ping some reason for the question. What have the winds had to do with the phenomena before us?

The winds, in this sense, are geological agents of great power. It is not impossible but that the afford us the means of comparing, directly, geological events which had taken place in one hemisphere geological events in another: *e. g.*, the tops of the Andes were once at the bottom of the sea. Which oldest formation, that of the Dead sea, or the Andes? If the former be the older, then the climate Dead sea must have been hygrometrically very different from what it now is.

In regarding the winds as geological agents, we can no longer consider them as the type of insta We rather behold them now in the light of ancient and faithful chroniclers, which, upon being rightly con will reveal to us truths which nature has written upon their wings in characters as legible and enduring has ever engraved the history of geological events upon the tablet of the rock.

*Robert A. Marr, U. S. N.

DARWIN the poet, suggested in the last century, the idea that the salt of the sea is washed into it by the rains and rivers from the land.

"Gnomes! you then taught transuding dews to pass
'Through time fall'n woods, and root-inwove morass
'Age after age; and with filtration fine
'Dispart, from earths and sulphurs and saline.
'Hence with diffusive salt old ocean steeps
'His emerald shallows, and his sapphire deeps.
'Oft in wild lakes around their brim
'In hollow pyramids, the crystals swim."*

The waters of Lake Titicaca, which receives the drainage of the great inland basin of the Andes, are only brackish, not salt.† Hence we may infer that this lake has not been standing long enough to become brine like the waters of the Dead sea; consequently it belongs to a more recent period. On the other hand it will also be interesting to hear that my friend Captain Lynch informs me, that in his exploration of the Dead sea, he saw what he took to be the dry bed of a river that once flowed from it. And thus we have two more links stout and strong, to add to the circumstantial evidence going to sustain the testimony of this strange and fickle witness which I have called up from the sea to testify in this presence concerning the works of nature, and to tell us which be the older, the Andes watching the stars with their hoary heads, or the Dead sea sleeping upon its ancient beds of crystal salt.

On the Saltness of the Sea.

In order to comprehend aright the currents of the sea, and to study with advantage the system of oceanic circulation, it is necessary to understand the effects produced by the salts of the sea upon the equilibrium of its waters; for wherever equilibrium be destroyed, whether in the air or water, it is restored by motion; and motion among fluid particles gives rise to currents, which in turn, constitute circulation. The question is often asked, "why is the sea salt?" I think it can be shown that the circulation of the ocean depends, in a great measure, upon the salts of sea water.

As a general rule, the sea is nearly of a uniform degree of saltness, and the constituents of sea water are as constant in their properties and as uniform in their proportions, as are the components of the atmosphere.

* Darwin, 1785.

† Lardner Gibbon, Passed Midshipman, U. S. N.—who in connection with Lieut. Wm. L. Herndon, U. S. N., is engaged in the most important expedition of the day, viz: exploring the valley of the Amazon—informs me by letter of August, 1851, from Cuzco, as follows, with regard to Lake Titicaca:

"We crossed a floating bridge, made of the lake reed, over the river or small stream Desaguadero, three fathoms deep, and about 50 yards wide, with a current of about ½ a mile per hour, flowing S. S. E. This stream is now at its lowest. In February it is at its highest, overflowing the lands on each side of the river, and showing a rise of 6 or 8 feet at the bridge with a furious current which sometimes carries away the bridge. I have specimens of the lake reed and some fish *without scales*. The reed is as thick as your little finger, and shaped like a bayonet—grows to the height of from 5 to 9 feet. The cattle eat it, and the people make salad of it. The Indians chew and suck it as they do the sugar cane. Their canoes, beds and bridges are made of it. Now this stream flows constantly to the South, out of the Lake Titicaca, for 80 leagues, into a small lake near Cerro Gordo (with an exception in 1846, when there were heavy rains to the South, and the stream took the back track for 30 days and flowed into Lake Titicaca.) The Indians tell me that they have found this lake *reed* on the Pacific coast near the port of Cobija. Although this lake has been called a salt lake, it is not so. The water is not in the least salt. The Indians drink it, though it is not so good as the water of the streams which flow into it."

We sometimes come across arms of the sea, or places in the ocean, where we find the water more s or less salt than sea water is generally; but this circumstance is due to local causes of easy explanation. instance: When we come to an arm of the sea, as the Red Sea, upon which it never rains, and from wh the atmosphere is continually abstracting, by evaporation, fresh water from the salt, we may naturally exp to find a greater proportion of salt in the sea water that remains, than we do near the mouth of some gr river, as the Amazon; or in the regions of constant precipitation, or other parts, where it rains more tha evaporates: and though therefore we do not find sea water from all parts of the ocean actually of the sa degree of saltness, yet we do find, as in the case of the Red Sea, sea water that is continually giving of evaporation fresh water in large quantities; nevertheless, for such water, there is a degree and a very mode degree of saltness which is a maximum; and we moreover find, that though the constituents of sea water, those of the atmosphere, are not for every place invariably the same as to their proportions, yet they are same or nearly the same as to their character.

When therefore we take into consideration the fact, that as a general rule, sea water is, with the exc tion above stated, every where and always the same, we find grounds on which to base the conjecture, the ocean has its system of circulation which is probably as complete and not less wonderful than is the culation of blood through our system.

In order to investigate the currents of the sea, and to catch a glimpse of the laws by which the circula of its waters is governed, hypothesis, in the present meagre state of absolute knowledge with regard to subject, seems to be as necessary to progress, as is a corner stone to a building. To make progress such investigations, we want something to build upon. In the absence of facts we are sometimes permi to suppose them; only, in making the selection of the various hypotheses which are suggested, we are bo to prefer that one to which the greatest number of phenomena will be reconciled. When we have found, tr and offered such an one, we are entitled to claim for it a respectful consideration at least, until we discov leading us into some palpable absurdity; or until some other hypothesis be suggested which will account equ well, but for a greater number of phenomena. Then, as honest searchers after truth, we should be read give up the former, adopt the latter, and to try it until some other better than either of the two be offered.

With this understanding, I venture to offer a hypothesis with regard to the agency of the salts or solid m of the sea in imparting dynamical force to the waters of the ocean in their system of circulation, and to sug that one of the purposes which in the Grand Design it was probably intended to accomplish by having the sea and not fresh, was to impart to its waters the forces and the powers necessary to make their circulation comp

In the first place, we do but conjecture when we say, that there is a set of currents in the sea and a syste circulation in the sea, by which its waters are conveyed from place to place, with regularity, certainty and or But this conjecture appears to be founded on reason, for if we take a sample of water wich shall fairly repre in the proportion of its constituents the average water of the Pacific ocean, and analyse it;—and if we d same by a similar sample from the Atlantic, we shall find the analysis of the one to resemble that of the o as closely as though the two samples had been taken from the same bottle after having been well shaken.

then shall we account for this, unless upon the supposition that sea water from one part of the world is in the process of time brought into contact and mixed up with sea water from all other parts of the world? Agents therefore, it would seem, are at work which shake up the waters of the sea as though they were in a bottle, and which, in the course of time, mingle those that are in one part of the ocean with those that are in another as thoroughly and completely as it is possible for man to do by shaking them in a vessel of his own construction.

This fact as to uniformity of components, appears to call for the hypothesis that sea water which to-day is in any part of the ocean, will, in the process of time, be found in another part the most remote. It must therefore be carried about by currents; and as those currents have their offices to perform in the terrestrial economy, they probably do not flow by chance, but in obedience to physical laws; they no doubt therefore maintain the order and preserve the harmony which characterize every department of God's handy-work upon the threshold of which man has yet been permitted to stand, to observe or to comprehend.

And thus by a process of reasoning, which is perfectly philosophical, we are led still further to conjecture that there are regular and certain, if not appointed channels, through which the water travels from one part of the ocean to another and that those channels belong to an arrangement which may make, and for ought we know to the contrary, which does make the system of oceanic circulation as complete, as perfect, and as harmonious as is that of the atmosphere or the blood. Every drop of water in the sea is as obedient to law and order, as are the members of the heavenly host in the remotest region of space. For when the morning stars sang together, "the waves also lifted up their voice" in the Almighty anthem; and doubtless therefore, the harmony in the depths of the ocean is in tune with that which comes from the spheres above. We cannot doubt it. For were it not so, were there no channels of circulation from one ocean to another, and if accordingly the waters of the Atlantic were confined to the Atlantic, or if the waters of the arms and seas of the Atlantic were confined to these arms and seas, and had on channels of circulation by which they could pass out into the ocean, and traverse different latitudes and climates, then the waters of these arms and seas would, as to their constituents, become in the process of time very different from the sea waters in other parts of the world.

For instance, take the Red sea and the Mediterranean by way of illustration; upon the Red sea there is no precipitation. It is in a rainless region; not a river runs down it; not a brook empties into it; therefore there is no process by which the salts and washings of the earth which are taken up and held in solution by rain or river water, can be brought down into the Red sea. The air takes up from it in the process of evaporation fresh water, leaving behind all the solid matter which the sea there holds in solution.

On the other hand, numerous rivers discharge into the Mediterranean; some of which are filtered through soils and among minerals which yield one kind of salts or soluble matter; another river runs through a limestone or volcanic region of country, and brings down in solution solid matter, it may be common salt, sulphate or carbonate of lime, magnesia, soda, potash or iron, either or all may be in its waters. Still the constituents of sea water from the Mediterranean, and of sea water from the Red sea, are quite the same. But the waters of the Dead sea have no connection with those of the ocean: they are cut off from its channels of

circulation and are therefore quite different as to their components from any arm, frith or gulf of the ocean.*

How therefore shall we account for this sameness of compound, but upon the supposition of a g system of circulation in the ocean, by which in the process of time, water from one part, is conveyed to a part the most remote, and by which a general interchange and commingling of the waters take place?

In like manner, the constituents of the atmosphere whether it be analysed at the equator or the are the same. By cutting off and shutting up from the general channels of circulation any portion water, as in the Dead sea, or of atmospheric air, as in mines or wells, we can easily fill either with gas other matter that shall very much effect its character and alter the proportions of its constituents.

The principal agents that are supposed to be concerned in giving circulation to the atmosphere, preserving the ratio among its components, are light, heat, electricity and perhaps magnetism; but as the motive power is concerned, or that agency by which the atmosphere that may now be within the tro wafted to the poles, heat and electricity are supposed to be the chief among them.

But with regard to the sea, it is not known what office is performed by electricity and magnetism in dynamical force to the system of oceanic circulation. The chief motive power from which marine c derive their velocity, has been ascribed to heat: but a close study of the agents concerned has suggested important—nay, a powerful and active agency in the system of oceanic circulation is derived, throu instrumentality of the winds, of marine plants and animals, from the salts of the sea water. They g ocean great dynamical force.

Let us, for the sake of illustration and explanation, suppose the sea in all its parts—in its depths, and surface, at the equator and about the poles—to be of one uniform temperature, and to be all of fresh wate this case, there would be nothing of heat to disturb its equilibrium, and there would be no motive power t currents, or to set the water in motion by reason of the difference of specific gravity due to water at d densities and temperatures.

As yet we have not taken into account in this supposition, the effects of the winds and of evapora begetting currents.

Let us therefore take them into account: but first the winds. The winds by their force create parti face currents and agitate the waters to a certain depth, and thus would give rise to a feeble and partial a circulation in the supposed seas of fresh water with a supposed uniform temperature.

* "The solid constituents of sea water amount to about 3½ per cent. of its weight, or neariy half an ounce to the pound. ness may be considered as a necessary result of the present order of things. Rivers which are constantly flowing into the ocean salts varying in amount from 10 to 50 and even 100 grains per gallon. They are chiefly common salt, sulphate and carbonate magnesia, soda, potash and iron; and these are found to constitute the distinguishing characteristics of sea water. The wat evaporates from the sea is nearly pure, containing but very minute traces of salts. Falling as rain upon the land, it washes percolates through the rocky layers, and becomes charged with saline substances which are borne seaward by the returning The ocean, therefore, is the great depository of every thing that water can dissolve and carry down from the surface of the contine as there is no channel for their escape, they of course consequently accumulate."—(*Yeomans' Chemistry.*)

"The case of the sea," says Fowner, "is but a magnified representation of what occurs in every lake into which rivers from which there is no outlet except by evaporation. Such a lake is invariably a salt lake. It is impossible that it can be ot and it is curious to observe that this condition disappears when an artificial outlet is produced for the waters."

This then is one of the sources whence power is given to the system of oceanic circulation; but though a feeble one, it is one which exists in reality, and therefore, need not be regarded as hypothetical.

Let us next call in evaporation and precipitation, that we may examine the effects of another and a more powerful agent. Suppose the evaporation to commence from this imaginary fresh water ocean, and to go on as it does from the seas as they are. In those regions, as in the trade wind regions, where evaporation is in excess of precipitation, the general level of this supposed sea would be altered, and immediately as much water as is carried off by evaporation would commence to flow in from North and South towards the trade-wind or evaporating region, to restore the level.

On the other hand, the winds have taken this vapor, borne it off to the extra-tropical regions and precipitated it, we will suppose, where precipitation is in excess of evaporation. Here is another alteration of sea level by elevation instead of by depression; and hence we have the motive power for a surface current from each pole towards the equator, the object of which is only to supply the demand for evaporation in the trade wind regions—demand for evaporation being taken here to mean the difference between evaporation and precipitation, or the quantity of water that is taken up into the air and carried, in the form of vapor, to other parts as before, from the trade wind region.

So far, we only derive from evaporation and precipitation over the supposed fresh water sea, a slight surface current towards the equator, and, of course, we have the forces for but a partial oceanic circulation.

The motive power of such a current would be gravitation, acting upon an inclined plane.

So far in the progress of illustration we have apparent counteraction; for we have, on one hand, the sea level lowered in the equatorial regions by evaporation, and raised by the expansive force of heat on the other; we have also the sea-level of the Polar regions raised on one hand by precipitation, and lowered on the other by the contraction due the diminution of temperature there. But this counteraction is only apparent, for the increase of temperature about the equatorial, and the decrease of it about the Polar regions can only produce a certain effect, which, like the effect of the centripedal force upon the figure of the Earth, in elevating the sea-level at the equator, becomes constant, and which like every other constant in nature, is compensated; whereas the process of evaporation and precipitation being continued, the difference of level created by these in different parts of the ocean is accumulative and not constant. It, therefore, remains for currents to restore.

We have now traced from their principles of action the effect of two agents, which in a sea of fresh water would tend to create currents, and to beget a system of aqueous circulation; but a set of currents and a system of circulation, which, it is readily perceived, would be quite different from those which we find in the salt sea. One of these agents would be employed in restoring, by means of one or more Polar currents, the water that is taken from one part of the ocean by evaporation, and deposited in another by precipitation. The other agent would be employed in restoring, by the forces due difference of specific gravity, the equilibrium, which has been disturbed by heating, and of course expanding, the waters of the Torrid Zone on one hand, and by cooling, and consequently contracting, those of the Frigid Zone on the other. This agency would, if it were not modified by others, find expression in a system of currents and counter currents, or rather in a set of surface

currents of warm and light water from the equator towards the poles, and in another set of under current: cooler, dense, and heavy water, from the poles towards the equator.

Such, keeping out of view the influence of the winds which we may suppose would be the same whe the sea were salt or fresh, would be the system of oceanic circulation were the sea all of fresh water. But f water in cooling begins to expand near the temperature of 40°, and expands more and more till it reaches freezing point and ceases to be fluid. This law of expansion by cooling, would impart a peculiar featur the system of oceanic circulation were the waters all fresh. Water at the temperature of 40° would be a maximum of density. Raise or lower the temperature from that and the water would expand; of course, t it would grow lighter and ascend to the surface. Therefore, when the warm waters of the Torrid Zone flowing North and cooling down to 40°, for instance, should meet the cold current coming from the Pola sin with a temperature of 34°, the current from the equator being of denser water would sink, and the cu from the Frigid Zone would then appear as a surface current until the temperature should rise to 40° foi ample. Here the current from the equator would be 50° we may suppose, and there would be another in the system of fresh water circulation; for here, at this latter place of meeting, the current from the regions, which all along had been of the lighter water, and therefore on the surface, would now becom heavier, disappear from the surface, sink and continue its course as an under current.

If this train of reasoning be good, we may infer that in a system of oceanic circulation, the dynamical to be derived from difference of temperature, where the waters are all fresh, would be quite feeble. Anc were the sea not salt, we should probably have no such current in it as the Gulf Stream.

So far we have been reasoning hypothetically to show what would be the chief agents exclusive winds in disturbing the equilibrium of the ocean, were its waters fresh and not salt. And whatever di equilibrium there, may be regarded as the *primum mobile* in the system of marine currents.

Let us now proceed another step in the process of explaining and illustrating the effect of the salts sea in the system of oceanic circulation. To this end, let us suppose this imaginary ocean of fresh wate denly to become that which we have, viz: an ocean of salt water which contracts as its temperature is lo till it reaches 28° or thereabout.

Let evaporation now commence in the trade wind region, as it was supposed to do in the case of the water seas, and as it actually goes on in nature—and what takes place? Why a lowering of the sea le before. But as the vapor of salt water is fresh or nearly so, fresh water only is taken up from the that which remains behind is therefore more salt; thus while the level is lowered in the salt sea, the equil is destroyed because of the saltness of the water, for the water that remains after the evaporation takes is, on account of the solid matter held in solution, specifically heavier than it was before any portion of converted into vapor.

The vapor is taken from the surface water; the surface water thereby becomes more salt and conse heavier; it therefore sinks; and hence we have due to the salts of the sea, a vertical circulation, viz: a of heavier—because salter and cooler—water from the surface, and an ascent of water that is lighter—l it is not so salt—from the depths below.

This vapor then which is taken up from the evaporating regions—by which is meant those regions where the evaporation is greater than the precipitation,—is carried by the winds through their channels of circulation and poured back into the ocean where the regions of precipitation are;—and by the regions of precipitation I mean those parts of the ocean, as in the polar basins, where the ocean receives more fresh water in the shape of rain, snow, &c., than it returns to the atmosphere in the shape of vapor.

In the precipitating regions therefore, the level is destroyed, as before explained, by elevation; and in the evaporating regions, by depression; which as already stated, gives rise to a system of surface currents moved by gravity alone from the poles towards the equator.

But we are now considering the effects of evaporation and precipitation in giving impulse to the circulation of the ocean where its waters are salt.

The fresh water that has been taken from the evaporating regions is deposited upon those of precipitation which, for illustration merely, we will locate in the North Polar basin. Among the sources of supply of fresh water for this basin, we must include not only the precipitation which takes place over the basin itself, but also the amount of fresh water discharged into it by the rivers of the great hydrographical basins of Arctic Europe, Asia, and America.

This fresh water, being emptied into the Polar sea, and agitated by the winds, becomes mixed with the salt; but as the agitation of the sea by the winds extends to no great depth, it is only the upper layer of salt water, and that to a moderate depth, which becomes mixed with the fresh. The specific gravity of this upper layer therefore is diminished just as much as the specific gravity of the sea water in the evaporating regions was increased. And thus we have a surface current of saltish water from the poles towards the equator, and an under current of water salter and heavier from the equator towards the poles. This under current supplies in a great measure the salt which the upper current, freighted with fresh water from the clouds and rivers, carries back.

Thus it is to the salts of the sea, that we owe that feature in the system of oceanic circulation which causes an under current to flow from the Mediterranean into the Atlantic, and another from the Red sea into the Indian ocean. And it is evident since neither of these seas is salting up,—that just as much, or nearly just as much salt as the under current brings out, just so much must the upper currents carry in.

We now begin to preceive what a powerful impulse is derived from the salts of the sea in giving effective and active circulation to its waters.

Hence, we infer that the currents of the sea, by reason of its saltness, attain their maximum of volume and velocity. Hence, too, we infer that the transportation of warm water from the Equator towards the frozen regions of the Poles, and of cold water from the Frigid towards the Torrid Zone, is facilitated; and consequently here, in the saltness of the sea, have we not an agent by which climates are mitigated—by which they are softened and rendered much more salubrious than it would be possible for them to be, were the waters of the ocean deprived of this property of saltness?

If these inferences as to the influence of the salts upon the currents of the sea, be correct, the same cause

which produces an under current from the Mediterranean, and an under current from the Red sea into the ocean, should produce an under current from the ocean into the north polar basin—it being supposed merely for the present that there is a surface current through Davis' Straits, always setting out of the Polar sea. In each case the hypothesis with regard to the part performed by the salt in giving vigor to the system of oceanic circulation requires that, counter to the surface current of water with less salt, there should be an under current of water with more salt in it.

That such is the case with regard both to the Mediterranean and the Red sea, has been amply shown in other parts of this work, and abundantly proved by other observers.

That there is a constant current setting out of the Arctic ocean through Davis' and other straits thereabout, which connects it with the Atlantic ocean, is generally admitted. Lieut. De Haven, U. S. N., when in command of the American expedition in search of Sir John Franklin, was frozen up with his vessels in the main channel of Welington straits; and during the nine months that he was so frozen, his vessels holding their place in the ice, were drifted with it bodily for more than a thousand miles towards the south.

The ice in which they were bound was of sea water, and the currents by which they were drifted were of sea water—only, it may be supposed, the latter were not quite so salt as the sea water generally is.

Then since there is salt always flowing out of the north polar basin, there must be salt always flowing into it, else it would either become fresh or the whole Atlantic ocean would be finally silted up with salt.

It might be supposed, were there no evidence to the contrary, that this salt was supplied to the Polar seas from the Atlantic around North Cape, and from the Pacific through Bhering's straits, and through no other channels.

But fortunately Arctic voyagers, who have cruised in the direction of Davis' straits, have afforded us proof positive as to the fact of this other source for supplying the Polar seas with salt. They tell us of an under current setting from the Atlantic towards the Polar basin. They describe huge icebergs with tops reaching high up in the air, and of course the basis of which extend far down into the depths of the ocean, ripping and tearing their way with terrific force and awful violence through the surface ice or against a surface current.

Passed Midshipman S. P. Griffin, who commanded the Brig "Rescue," in the American searching expedition after Sir John Franklin, informs me that on one occasion the two vessels were endeavoring to warp up to the northward in or near Wellington channel, against a strong surface current, which of course was setting to the south; and that while so engaged, an iceberg with its top many feet above the water, came "difting up," from the south, and passed by them "like a shot," although they were stemming a surface current against both the berg and themselves. Such was the force and velocity of the under current, that it carried the berg to the northward faster than the crew could warp the vessel against a surface but counter current.

Capt. Duncan, Master of the English whale ship Dundee, says, at page 76 of his interesting little narrative,

"*Dec.* 18*th*, (1826)—It was awful to behold the immense icebergs working away to the northeast from us and not one drop of water to be seen; they were working themselves right through the middle of the ice."

And again at page 92, &c:

"*Feb.* 23*d*—Latitude 68° 37′ N., Longitude about 63° W.

"The dreadful apprehensions that assailed us yesterday by the near approach of the iceberg, were this day most awfully verified. About 3 P. M. the iceberg came in contact with our floe, and in less than one minute it broke the ice; we were frozen in quite close to the shore; the floe was shivered to pieces for several miles, causing an explosion like an earthquake or one hundred pieces of heavy ordnance fired at the same moment. The iceberg, with awful but majestic grandeur, (in height and dimensions resembling a vast mountain,) came almost up to our stern, and every one expected it would have run over the ship. * * *

"The iceberg, as has been before observed, came up very near to the stern of our ship; the intermediate space between the berg and the vessel was filled with masses of heavy ice, which though they had been previously broken by the immense weight of the berg, were again formed into a compact body by its pressure. The berg was drifting at the rate of about four knots, and by its force on the mass of ice, was pushing the ship before her, as it appeared, to inevitable destruction."

"*Feb. 24th.*—The iceberg still in sight, but driving away fast to the N. E."

"*Feb. 25th.*—The iceberg that so lately threatened our destruction, had driven completely out of sight to the N. E. from us."—*Arctic Regions—voyage to Davis' Strait, by Dorea Duncan, Master of the Ship Dundee*, 1826–7.

Now then whence, unless from the difference of specific gravity due sea water of different degrees of saltness, can we derive a locomotive power with force sufficient to give such tremendous masses of ice such a velocity?

What is the temperature of this under current? Be that what it may, it is probably above the freezing point of sea water. Suppose it to be at 36°. Break through the ice in the northern seas, and the temperature of the water is always 28°. At least Lieut. De Haven so found it in his long imprisonment, and it may be supposed that as it was with him, so it generally is. Assuming then the water of the surface current which runs out with the ice to be all at 28°, we observe that it is not unreasonable to suppose that the water of the under current, inasmuch as it comes from the South, and therefore from warmer latitudes, is probably not so cold, and if it be not so cold, its temperature before it comes out again must be reduced to 28°, or whatever be the average temperature of the outer but surface current.

Moreover, if it be true as some philosophers have suggested, that there is in the depths of the ocean a line from the equator to the poles, along which the water is of the same temperature all the way, then the question may be asked: should we not have in the depths of the ocean, a sort of isothermal floor, as it were, on the upper side of which all the changes of temperature are due to agents acting from above, and on the lower side of which the changes, if any, are due to agents acting from below?

This under Polar current water then, as it rises to the top, and is brought to the surface by the agitation of the sea in the Arctic regions, gives out its surplus heat and warms the atmosphere there till the temperature of this warm under current water is lowered to the requisite degree for going out on the surface. Hence the water-sky of those regions.

And the heat that it loses in falling from its normal temperature, be that what it may, till it reaches the temperature of 28°, is so much caloric set free in the Polar regions to temper the air and mitigate the climate

there. Now is not this one of those modifications of climate, which may be fairly traced back to the effect of the saltness of the sea in giving energy to its circulation?

Moreover, if there be a deep sea in the Polar basin which serves as a receptacle for the waters brought into it by this under current which, because it comes from towards the equatorial regions, comes from a milder climate, and is, therefore, warmer, we can easily imagine why there might be an open sea in the Polar regions;—why Lieut. De Haven in his instructions was directed to look for it; and why, both he, and Capt. Penny of one of the English searching vessels, found it there.

And in accounting for this Polynia, we see that its existence is not only consistent with the hypothesis with which we set out touching a perfect system of oceanic circulation, but that it may be ascribed, in a great degree at least, if not wholly, to the effect produced by the salts of the sea upon the mobility and circulation of its waters.

Here then is an office which the sea performs in the economy of the universe by virtue of its saltness, and which it could not perform were its waters altogether fresh. And thus philosophers have a clue placed in their hands which will probably guide them to one of the many hidden reasons that are embraced in the true answer to the question, "why is the sea salt?"

But we find in sea water other matter besides common salt. Lime is dissolved by the rains and the rivers, and emptied in vast quantities into the ocean. Out of it, coral islands and coral reefs of great extent—marl beds, shell banks, and infusorial deposits of large dimensions, have been constructed by the inhabitants of the deep.

These creatures are endowed with the power of secreting, apparently for their own purposes only, solid matter which the waters of the sea hold in solution. But this power was given to them that they also might fulfill the part assigned them in the economy of the universe. For to them, probably, has been allotted the important office of assisting in giving circulation to the ocean, and of helping to regulate the climates of the earth.

The better to comprehend how such creatures may influence currents and climates, let us suppose the ocean to be perfectly at rest;—that throughout, it is in a state of complete equilibrium;—that, with the exception of those tenants of the deep which have the power of extracting from it the solid matter held in solution, there be no agent in nature capable of distributing that equilibrium;—and that all these fish, &c., have suspended their secretions in order that this state of a perfect aqueous equilibrium and repose throughout the sea, might be attained.

In this state of things—the waters of the sea being in perfect equilibrium—a single mollusk or coralline, we will suppose, commences his secretions, and abstracts from the sea water, solid matter for his shell. In that act, this animal has destroyed the equilibrium of the whole ocean; for the specific gravity of that portion of water from which this solid matter has been abstracted is altered. Having lost a portion of its solid contents, it has become specifically lighter than it was before; it must, therefore, give place to the pressure which the heavier water exerts to push it aside and occupy its place, and it must consequently travel about and mingle with the waters of the other parts of the ocean until its proportion of solid matter be returned to it, and until it attains the exact degree of specific gravity due sea water generally.

How much solid matter does the whole host of marine plants and animals abstract from sea water daily? Is it a thousand pounds or a thousand millions of tons? No one can say. But whatever be its weight, it is so

much of the power of gravity applied to the dynamical forces of the ocean. And this power is derived from the salts of the sea, through the agency of sea shells and other marine animals, that of themselves scarcely possess the power of locomotion. Yet they have power to put the whole sea in motion, from the equator to the poles, from the surface to the bottom.

Those powerful and strange equatorial currents which navigators tell us they encounter in the Pacific ocean—to what are they due? Coming from sources unknown, they are lost in the midst of the ocean. They appear to originate in the open sea, and in the open sea to terminate. How far may they be due to the derangement of equilibrium arising from the change of specific gravity caused by the secretions of the myriads of marine animals that are continually at work in those parts of the ocean? These abstract from sea water solid matter enough to build continents of.

Thus when we consider the salts of the sea in one point of view, we see the winds and the marine animals operating upon the waters, and in certain parts of the ocean deriving from the solid contents of the same, those very principles of antagonistic forces which hold the earth in its orbit, and preserve the harmonies of the universe.

The sea breeze and the sea shell, in performing their appointed offices, act in such a way as to give rise to a reciprocating motion in the waters: thus they impart to the ocean dynamical forces for its circulation.

The sea breeze plays upon the surface: it converts only fresh water into vapor, and leaves the solid matter behind. The surface water thus becomes specifically heavier, and sinks. On the other hand, the little marine architect below, as he works upon his coral edifice at the bottom, abstracts from the water there a portion of its solid contents; it, therefore, becomes specifically lighter, and up it goes ascending to the top with increased velocity, to take the place of the descending column, which by the action of the winds has been sent down loaded with fresh food and materials for the busy little mason in the depths below.

Seeing then that the inhabitants of the sea with their powers of secretion are competent to exercise at least some degree of influence in disturbing equilibrium—are not these creatures entitled to be regarded as agents which have their offices to perform in the system of oceanic circulation? It is immaterial how great or how small that influence may be supposed to be; for be it great or small, we may rest assured it is not a chance influence, but it is an influence exercised—if exercised at all—by design, and according to the commandment of Him whose "voice the winds and the sea obey." Thus God speaks through sea-shells to the ocean.

It may therefore be supposed that the arrangements in the economy of nature are such as to require that the various kinds of marine animals, whose secretions are calculated to alter the specific gravity of sea water, to destroy its equilibrium, to beget currents in the ocean, and to control its circulation, should be distributed according to order.

Upon this supposition—the like of which nature warrants throughout her whole domain—we may conceive how the marine animals of which we have been speaking, assist also to regulate climates and to adjust the temperature of certain latitudes. For instance, let us suppose the waters in a certain part of the Torrid Zone to be 70°, but by reason of the fresh water which has been taken from them in a state of vapor, and consequently by reason of the proportionate increase of salts, these waters are heavier than waters that may be cooler but not

so salt. This being the case, the tendency would be for this warm but salt and heavy water to flow off as an under current towards the Polar or some other regions of lighter water.

Such an under current, by reason of the limited conducting powers of water for heat, would preserve its high temperature for a length of time, and for great distances—cooling, of course, somewhat by the way.

This under current may be freighted with heat to temper some hyperborean region, or to soften some extratropical climate; for we know that such is among the effects of marine currents. At starting it might have been, if you please, so loaded with solid matter that though its temperature were 70°, yet by reason of the quantity of such matter held in solution, its specific gravity might have been greater than that of extra-tropical sea water generally at 28°.

Notwithstanding this, it may be brought into contact, by the way, with those kinds and quantities of marine organisms that shall abstract solid matter enough to reduce its specific gravity, and instead of leaving it greater than common sea water at 28°, to make it less than common sea water at 40°; consequently, in such a case this warm sea water, when it comes to the cold latitudes, would be brought to the surface through the instrumentality of shell fish and various other tribes that dwell far down in the depths of the ocean. Thus we perceive that these creatures, though they are regarded as being so low in the scale of creation, may, nevertheless, be regarded as agents of much importance in the terrestrial economy, for we perceive that they are capable of spreading over certain parts of the ocean those benign mantles of warmth which temper the winds and modify, more or less, all the marine climates of the earth.

The makers of nice astronomical instruments, when they have put the different parts of their machinery together and set it to work, find as in the chronometer for instance, that it is subject in its performance to many irregularities and imperfections. That in one state of things, there is expansion, and in another state contraction among cogs, springs and wheels with an increase or diminution of rate. This defect, the makers have sought to overcome; and with a beautiful display of ingenuity, they have attached to the works of the instrument a contrivance which has had the effect of correcting these irregularities, by counteracting the tendency of the instrument to change its performance with the changing influences of temperature.

This contrivance is called a *compensation;* and a chronometer that is well regulated, and properly compensated, will perform its office with certainty, and preserve its rate under all the vicissitudes of heat and cold to which it may be exposed.

So too in the clock-work of the ocean, and the machinery of the universe: order and regularity are maintained by a system of compensations. A celestial body as it revolves around its sun, flies off under the influence of centrifugal force; but immediately the forces of compensation begin to act: the planet is brought back to its elliptical path, and held in the orbit for which its mass, its motions and its distance were adjusted. Its compensation is perfect.

So too with the salts and the shells of the sea in the machinery of the ocean: from them are derived principles of compensation, the most perfect; through their agency the undue effects of heat and cold, of storm and rain in disturbing the equilibrium and producing thereby currents in the sea, are compensated, regulated, and controlled.

The dews, the rains and the rivers are continually dissolving certain minerals of the earth, and carrying them off to the sea. This is an accumulating process; and if it were not *compensated*, the sea would finally become as the Dead Sea is, saturated with salt, and therefore unsuitable for the habitation of many fish of the sea.

The sea shells and marine insects afford the required *compensation.* As the salts are emptied into the sea, these creatures secrete them again and pile them up in solid masses, to serve as the bases of islands and continents, to be in the process of ages upheaved into dry land, and then again dissolved by the dews and rains and washed by the rivers away into the sea.

Darwin, many years ago,* during one of those moments of inspiration which enabled him to foreshadow the steamboat and the locomotive, told philosophers whence came the salts of the sea.

In every department of nature there is to be found this self-adjusting principle—this beautiful and exquisite system of *compensation* by which the operations of the grand machinery of the universe are maintained in the most perfect order.

Thus we behold sea shells and animalculæ in a new light. May we not now cease to regard them as beings which have little or nothing to do in maintaining the harmonies of creation? On the contrary, do we not see in them, the principles of the most admirable compensation in the system of oceanic circulation? We may even regard them as regulators, to some extent, of climates in parts of the earth far removed from their presence. There is something suggestive, both of the grand and beautiful, in the idea that while the insects of the sea are building up their coral islands in the perpetual summer of the tropics, they are also engaged in dispensing warmth to distant parts of the earth, and in mitigating the severe cold of the Polar winter.

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* Gnomes! You then taught transuding dews to pass,
Through time-fall'n woods, and root-inwove morass
Age after age; and with filtration fine
Dispart from earths and sulphurs and saline.
Hence with diffusive salt old ocean steeps
His emerald shallows, and his sapphire deeps.
Oft in wide lakes, around their warmer brim,
In hollow pyramids the crystals swim;
Or, fused by earth-born fires in cubic blocks,
Shoot their white forms, and harden into rocks.
Thus caverned round in Cracow's mighty mines,
With crystal walls, a gorgeous city shines;
Scooped in the briny rock, long straits extend
Their hoary course, and glittering domes ascend;
Down the bright steeps, emerging into day,
Impetuous fountains burst their headlong way,
O'er milk-white vales in ivory channels spread,
And wandering, seek their subterraneous bed,
Formed in pellucid salt with chisel nice,
The pale lamp glimmering through the sculptured ice;
With wide reverted eyes fair Lotta stands,
And spreads to Heaven, in vain, her glassy hands;
Cold dews condense upon her pearly breast,
And the big tear rolls lucid down her vest.

Surely an hypothesis which, being followed out, suggests so much design, such perfect order and arrangement, and so many beauties for contemplation and admiration as does this, which for the want of a better I have ventured to offer with regard to the solid matter of the sea water, its salts and its shells, surely such an hypothesis, though it be not based entirely on the results of actual observation, cannot be regarded as wholly vain, or as altogether profitless.

The open Sea in the Arctic Ocean.

As a supplement to this chapter I may be excused for introducing Lieut. De Haven's Report after his return from the Arctic ocean in search of Sir John Franklin and his companions. The instructions under which he went, and the source whence those instructions were in a measure drawn, make us acquainted with a few facts that throw some light upon the circulation of the ocean, so far as the salts of the sea are concerned in imparting dynamical forces to it.

His instructions, based entirely upon theory and the convictions of the mind in the correctness of its reasoning and powers of deduction, pointed him to an open sea, in the midst of the ice, and he found it there.

In the instructions which issued from the Navy Department for his guidance during that expedition, stress was laid upon an open sea to the Northward and Westward of Wellington channel.

"There are other facts," he was told in these instructions, "elicited by Lieut. Maury in the course of his investigations touching the winds and currents of the ocean, which go also to confirm the opinion that beyond the icy-barrier which is generally met in the Arctic ocean, there is a polynia or sea free from ice."

Moreover, Lieut. De Haven was reminded in these instructions that it was needless to repeat to him the reasons for asserting so confidently the existence of this open sea, because, said his instructions, "you have assisted in those investigations at the National Observatory, and are doubtless aware of the circumstances which authorize this conclusion."

These circumstances are detailed in the following letter which was then on the files of the Department, and which had been written soon after the American whalers had been first invited to seek information concerning the missing expedition.

Lieutenant Maury to Commodore Warrington.

National Observatory,
Washington, July 16th, 1849.

"Sir: I have had under consideration the subject matter of Walter R. Jones' letter to the President of the United States, and in compliance with your request beg leave to state in reply thereto:—

That the best information with regard to Bhering's straits, and the sea into which they lead is to be found in the English and Russian charts of the Arctic seas; though Captain Roys, who, in the whale-ship "Superior," cruised there in the summer of last year, reports that these charts contain many errors. Captain Roys could

not determine the amount of these errors, he merely ascertained that there were errors in the best and latest Russian charts.

It cannot be expected that vessels like Mr. Jones', whose more immediate object is the pursuit of fish, will, as daring and adventurous as our whalemen are known to be, attempt to penetrate into the frozen ocean farther than the open sea will admit, or their game may entice them.

The limits of the region of packed ice are variable. In 1827, the southern edge of the packed ice was found to commence about latitude 70° N., longitude 169° W., and to extend thence in a N. E. by E. course at least as far as longitude 160° W.

Sir John Franklin and his companions, to whom Mr. Jones wishes to carry relief, are in the unknown parts of the sea, and therefore, the information to be furnished, with regard to a well conducted search for him, must consist necessarily and chiefly of deductions and generalizations derived from the best received theories and opinions with regard to the climatology of those regions.

In the first place, it seems to be an admitted fact that there is a current setting North through Bhering's straits into the Frozen Ocean. Captain Roys found it setting at the rate of from 70 to 100 miles a day. This is probably a constant current, though it may be supposed it runs fastest in summer: the water which it bears along is of course supplied from the China seas; coming from the equatorial regions it is therefore warmer water than that of the Arctic Ocean into which it flows.

The physical forces that operate upon this current to give it motion, require that it should pursue, after entering the straits, a northeasterly course; so Capt. Roys found it. The edge of the packed ice there (already alluded to) seems also to confirm the opinion, that such is the course of this current. If so, the water thermometer will tell, and Mr. Jones' ships will be assured of the fact by the existence of a Polynia stretching up in that direction.

How far such an iceless sea will be found to extend to the eastward, should its existence be established, observations can alone determine. But as a guide I beg to send the accompanying chart, on which Passed Midshipman Gibbon has at my request projected the isothermal curves of 5° and 10°, from Johnson's Physical Atlas.

These curves are, according to Sir David Brewster, probably lemniscates; and as it is conjectured that there are two poles of maximum cold, viz: one in latitude 80° N. and longitude 100° W., and the other in latitude 80° N. and longitude 95°E. the mean temperature of the former which is the American pole, is, according to Sir David Brewster 3½ degrees below zero of Fahrenheit, while that of the other or Siberian pole, is 1° above zero of the same scale.

The line of packed ice is probably a curve, depending for its form partly upon isothermal lines, and partly upon the eddies caused by the meeting of the various currents in the Arctic ocean.

Supposing two such poles to exist in nature, the isothermal lines about them would be re-entering curves, the exact form of which however cannot be determined without the aid of further observations.

But according to this theory, the mean temperature of the North pole itself will differ not much from the mean temperature of Lat. 70° N.

In entering into Bhering's Straits and following up the coast of West Georgia, the whalers may make icy barrier perhaps about 160° W. between Lat. 70° and 72° N. In this position they will find themsel in a straight line, not more than a thousand miles from Wellington Straits on the Atlantic shores of Amer and not much more than half that distance from Bank's Land. To the N. E. of this land are the Parry Islan to the North of those the sea is by some thought to be again polynial or free from ice.

In the Arctic ocean the prevailing winds are from the westward; so that a vessel under canvass enterii through Bhering's straits, would have probably a better chance of making her way through, than one w enters on this side and to leeward, and which therefore would have occasionally to turn to windward, for much of her time, to contend against adverse currents.

To a vessel entering Bhering's straits, the current would also be favorable, for there *must* be curren that sea to supply those which come down from Baffin's Bay, into the Atlantic.

These currents would materially assist the navigator in his progress Eastward through the Arctic seas, they would retard him to the same extent in his progress West through the same seas.

You are aware that there is a current from Baffin's Bay, through Davis' Straits; this is a powerful cu and it moves an immense volume of water. A current as powerful must run into that bay from some quarter.

Laden with icebergs, this Baffin's Bay current meets the Gulf Stream near the Grand Banks where bifurcated; one fork continues as an under current towards the Caribbean Sea, and the other, pursuing its c to the South, is felt as an inshore current along the coast of the United States as far down as Florida. There counter current to this,* running back from the Atlantic through Davis' Straits.

Wrangle's Polynia, to the North of Siberia, if it exist, probably owes its freedom from ice to the waters of the Gulf Stream, which run between Spitzbergen and the North Cape into the Arctic ocean. such is the course of the Gulf Stream is clearly indicated by a thermal chart which is now in process of struction at this office, by Lieut. Guantt. This chart shows that the waters of the Atlantic in Lat. 68 above Ireland, are some degrees warmer than they are near the shore off Cape Hatteras in Lat. 36° N. difference in temperature for the spring is 8° or 10° of Fahrenheit.

Seeing therefore that the waters from the Gulf of Mexico run into the Arctic Ocean to the North o rope;—that the waters of the larger rivers both of Europe, Asia and America, such as the Dwina, the Pet the Obi, the Yenesei and Lena, the Mackensie's river, the rivers of Back, the Copper Mine and others, into the same ocean;—that waters from the Pacific flow into it through Behring's Straits;—that there is no from it through any of these channels, but that there is a powerful ice-bearing current running from it th Davis' Straits;—seeing all this, we are led reasonably to infer not only that there is a sea not frozen some between Behring's Straits and Baffin's Bay, but that the course of the current in that sea is such as has a been indicated, viz: from West to East.

The fact that these currents which run into the Arctic ocean and out of Baffin's Bay, do exist, ar

*NOTE.—Counter current to this; unless it be an under current as has since been proved.—M.

they are perpetual, leads us also to infer that a portion of the water of the Arctic ocean is always in motion—that the currents within that sea are as constant as those which run into it and out again from it; and that therefore a portion of that sea is always in a fluid state.

Without meaning however to commit myself as to the perpetual existence of Wrangle's open sea, I think there is reasonable ground for supposing that after entering Behring's Straits and passing the first icy barrier, an open sea may still be found to the North of that barrier.

It will be for the masters of whale ships themselves to judge as to the expediency of passing this barrier when they come to it, provided they find an opening. If they do find an opening and venture through it, they will probably be rewarded for their intrepidity by the discovery of whales in great numbers.

The kind of whales (Right) found there delight in cold water. Their *habitat* is never in warm. The discovery has been made here by the investigations which Lieut. Herndon is conducting with regard to the habits of the Right whale, that this fish never crosses the equator;—that the Right whale of the Southern Hemisphere is quite a different animal from the Right whale of the Northern Hemisphere.

The latter is of a darker complexion and much larger. Now if the species of whales that are found in Behring's Straits be found also off the shores of Greenland—and the whalemen will probably be able to say, (and they have since informed me that they are identical, Jan., 1850;) we shall have another link in the chain of circumstantial evidence going to prove that there is, at times, at least, an open water communication between the Straits of Behring and Davis.

But if Mr. Jones and his associates mean to be in good earnest in their humane efforts, and were to send their ships into Behring's Straits for the sole object of finding Sir John Franklin or a passage through into the Atlantic, they will probably accomplish one or both.

I have great faith in American enterprise and energy; with proper means that sea may be traversed, and the fate of that expedition may be determined; at least there is reasonable grounds for the opinion that an expedition properly fitted and skillfully conducted would be crowned with success, and would cover itself and its projectors with much honor.

Such an expedition should consist of at least three vessels—viz., one sailer and two steamers, all prepared especially for that service.

The sail ship should be large enough to hold the provisions for the expedition for two or three years, and coals also for the steamers during their few weeks of active work in the summer. A store ship should accompany them, to Bhering's straits, and there filling them up, leave them for the season and return.

Their course would then be to preceed on until their progress should be interrupted by the ice. Here they would select some safe place of anchorage or rendezvous for the ship; thus moored she would serve as a place of refuge and at the same time as a provision waggon. From her, the steamers would fit out an expedition of a few weeks at a time, and until they should succeed in finding an opening through it. Should they *succeed in* finding such an opening, they would probably have a clean sea thence until they should reach the icy barrier on this side: success in finding a channel way through this barrier would bring them out into the Atlantic Ocean.

The steamers of course should be properly constructed, and provided with ice breakers or saws by they could in case of emergency cut their way out through the ice as well as a way for their provision sh

The steamers for such service need not be large. Mr. Jones does not propose sending an expedition sively in search of Sir John Franklin, therefore those remarks do not apply to his case. But Mr Jone his associates, are evidently gentlemen of humane disposition and noble impulses, therefore I have ve to make these suggestions, feeling assured that they would be received as they are meant and only fo they are worth.

The "Huntsville" and the "Alice"* of course will not fail to be provided with faithful interpreter through them they will be sure to make diligent enquiries among the natives for intelligence of Sir John, a expedition. The Indians should be induced by presents or the promise of rewards to examine the coas and to enquire from tribe to tribe as to when and where he was last, if ever seen.

Doubtless these two private ships and their crews, will in the proposed voyage render a gratifyi acceptable service to the people of christendom.

Should it be desired, another chart, the duplicate of the one herewith sent, can be prepared at this so that each vessel may have one of the same kind. There are also other charts here, relating to Bh straits and Arctic America, which if so authorised, I shall be glad to put at the disposal of the masters "Huntsville" and "Alice."

P. S.—In the haste in which this letter has been necessarily prepared in consequence of being al leave the city on a tour of duty, many points have been either wholly omitted or but slightly attend among the most important of these is a suggestion concerning a depot of coals and provisions near Well Straits or some other suitable place this side, to which the steamers might look for supplies, in the e passing the icy barrier after entering Bhering's straits; and the other is concerning those causes which to form an icy barrier around the polynia.

The line of ice is probably placed near the meeting of the various curreuts within the Arctic Whenever two currents meet in the ocean, there is a belt of still, or of comparatively still water, within belts are deposited the floating bodies and silt that are borne by the currents. Hence we find bar mouth of all our rivers which empty directly into the sea. The Banks of Newfoundland owe their ex to this cause. The floating matter that is borne along by the Gulf stream and which is prevented from at the bottom by the rapidity of the current, is met near these banks by the cold current from Davis' strai the still water, near the line of junction between those two currents, this drift matter has time to sett consequently there is a deposite there of sediment—in like manner, the icebergs which bring down rock vel and sands, begin here to melt and to make deposites also.

And where there is on the sea, drift, or floating matter, such as sea weed, &c., we can see the line by the manner in which that matter is arranged.

Taking the case of the line of packed ice in the Arctic ocean, and refering to the chart, it will be pe

*Two Whaling vessels belonging to him.—M.

that this line, from the neighborhood of Bhering's straits runs up in a northwesterly direction, and that it probably lies along the line in which the currents from the rivers of Europe and Asia, probably many times the volume of the Mississippi, meet the current around the North cape from the Gulf of Mexico.

Again, after passing Bhering's straits and feeling the effect of that powerful current, this line bends up in a northeasterly direction.

The process may be supposed to be this—the ice which is forced in the current through Bhering's straits, and in the general current farther north towards Baffin's Bay, is broken to pieces by the agitation of the sea. These pieces are gradually sloughed off from either current and arranged in the eddy between the two currents, as we see drift-wood, &c., arranged by the side of counter currents in rivers and other sheets of water. The spray now dashes upon these blocks of ice, they become frozen and cemented together, until by gradual accession they form a compact and immense mass of packed ice, for that is the term applied by seamen. This mass therefore is probably not very broad. It may, after attaining a certain height, be broken through either by the pressure of the current whose course it has arrested, or by the violence of the winds, or the waves, or by all these forces acting together; so it is very probable that the sea within this barrier will be found free or nearly free from floe ice—and comparatively smooth, for the barrier of ice will serve for a breakwater, or like a coral reef, will shelter it from the winds and protect it from the forces of the swell on the outside.

Should a steamer, therefore, by Bhering's straits, succeed in passing through the first barrier of ice, she would probably have the water so smooth that after a few days steaming, she would find herself up with the icy barrier that would block her way into Wellington's or some other of the straits that lead out into Baffin's Bay."

Extracts from the Instructions issued by the Hon. Wm. A. Graham, Secretary of the Navy, to Lieut. De Haven, commanding the Grinnel expedition in search of Sir John Franklin.

"You will, therefore, use all diligence and make every exertion to this end; paying attention as you go to the subjects of scientific inquiry only so far as the same may not interfere with the main object of the expedition.

Having passed Barrow's straits, you will turn your attention northward to Wellington Channel, and westward to Cape Walker, and be governed by circumstances as to the course you will take. Accordingly, you will exercise your own discretion, after seeing the condition of the ice, sea, and weather, whether the two vessels shall here separate, one for Cape Walker and the other for Wellington Strait; or, whether they shall both proceed together for one place or the other.

Should you find it impossible, on account of the ice, to get though Barrow's strait, you will then turn your attention to Jones' Sound and Smith's Sound. Finding these closed or impracticable, and failing of all traces of the missing Expedition, the season will be too far advanced for any other attempts, and you will return to New York.

Acquaint, before sailing, and from time to time during the cruize, Passed Midshipman Griffin, fully with all your plans and intentions, and before you sail from New York appoint a place of rendezvous;—change it as often as circumstances may render a change desirable; but always have a place of rendezvous fixed upon—so

that in case the two vessels of the Expedition may at any time become separated, each may know whe look for the other.

Nearly the entire Arctic front of the continent has been scoured without finding any traces of the mi ships. It is useless for you to go there, or to re-examine any other place where search has already been n You will, therefore, confine your attention to the routes already indicated.

The point of maximum cold is said to be in the vicinity of the Parry Islands. To the north and w these, there is probably a comparatively open sea in summer, and therefore a milder climate.

This opinion seems to be sustained by the fact that beasts and fowls are seen migrating over the ice the mouth of Mackenzie River and its neighboring shores to the North. These dumb creatures are pro led by their wise instincts to seek a more genial climate upon the borders of the supposed more open sea.

There are other facts elicited by Lieut. Maury, in the course of his investigations touching the wind currents of the ocean, which go also to confirm the opinion that beyond the icy barrier which is generall within the Arctic ocean, there is a Polinia, or sea free from ice. You have assisted in these investigati the National Observatory, and are doubtless aware of the circumstances which authorize this conclusio is therefore needless to repeat them.

This supposed open sea and warmer region to the North and West of the Parry Islands, are unexp Should you succeed in finding an opening there, either after having cleared Wellington Strait or after h cleared the Parry Islands by a northwesterly course from Cape Walker, enter as far as it in your jud may be prudent to enter, and search every headland, promontory and conspicuous point, for signs and r of the missing party, taking particular care yourself to avail yourself of every opportunity for leaving as y records and signs to tell of your welfare, progress and intentions. For this purpose you will erect flag- make piles of stones or other marks in conspicuous places, with a bottle or barreca at the base containin letters.

Should the two vessels be separated you will direct Passed Midshipman Griffin to do likewise. yourself of every opportunity, either by the Esquimaux or otherwise, to let the Department hear from yo in every communication be particular as to your future plans and intended route.

If by any chance you should penetrate so far beyond the icy barrier as to make it in your judgmen prudent to push on than to put back, you will do so, and put yourself in communication with any of the naval forces or officers of the Government, serving, in the waters of the Pacific, according to your nec and opportunities. These officers will be instructed to afford you every facility possible to enable you t the western coast of the U. S. in September.

In the event of your falling in with any of the British searching parties, you will offer them any ass of which they may stand in need, and which it may be in your power to give. Offer also to mak acquainted with your intended route and plans, and be ready to afford them every information of whi may have become possessed with regard to the object of your search.

In case your country should be involved in war during your absence on this service, you will on

count commit, or suffer any one on the expedition to commit any, the least, act of hostility against the enemy of whatever nation he may be.

Notwithstanding the direction towards which you have been recommended to carry your examination, you may, on arriving out upon the field of operation, find that by departing from them your search would be more effectual. The Department has every confidence in your judgment and relies implicitly upon your discretion; and should it appear during the voyage, that by directing your attention to the points not mentioned in this letter, traces of the absent explorers would probably be found, you will not fail to examine such points.

But you will on no account uselessly hazard the safety of the vessels under your command, or unnecessarily expose to danger the officers and men committed to your charge.

Unless circumstances should favor you by enabling you to penetrate, before the ice begins to make, far into the unexplored regions, or to discover recent traces of the missing ships and their gallant crews, or unless you should gain a position from which you could commence operations in the season of 1851, with decided advantage, you will endeavor not to be caught in the ice during the coming winter; but after having completed your examinations, make your escape and return to New York in the fall.

You are especially enjoined not to spend, if it can be avoided, more than one winter in the Arctic regions.

Wishing you and your gallant companions all success in your noble enterprise, and with the trust in God that he will take you and them in his Holy keeping."

I am, &c.

Lieut. DeHaven's Report.

U. S. Brig Advance,

New York, October 4, 1851.

Sir: I have the honor to submit the following as the proceedings of the squadron under my command, subsequent to the 22d of August, 1850, up to which time the department is already advised of its movements.

On the 23d of August we approached "Port Leopold," but the necessity of a detention here to search for information was precluded by our falling in with the English yacht "Prince Albert," Commander Forsyth, R. N. He informed us that the harbor was still filled with ice, so as to render it inaccessible to vessels. A boat, however, had been sent in, but no traces of the missing expedition were found.

We now stood over for the north shore, passing to the eastward of Leopold island, threading our way through much heavy stream ice. Barrow's straits, to the westward, presented one mass of heavy and closely packed ice, extending close into the coast of North Somerset. On the north shore we found open water, reaching to the westward as far as Beechy island.

At noon on the 25th we were off Cape Riley, where the vessel was hove to, and a boat sent ashore to examine a cairn erected in a conspicuous position. It was found to contain a record of H. B. M.'s ship Assistance, deposited the day before. Another record informed us that our consort had visited the cape at the same time with the Assistance.

Fragments of painted wood and preserved meat-tins were picked up on the low point of the cape; there

were also other indications that it had been the camping ground of some civilized traveling or hunting party; our speculations at once connected them with the object of our search.

While making our researches on shore, the vessel was set by a strong current near the point, where, becoming hampered by some masses of ice, she took the ground. Every effort was made to get her off, but the falling tide soon left her "hard and fast." We now lightened her of all weighty articles about deck, and prepared to renew our efforts when the tide should rise. This took place about midnight, when she was hauled off without apparent injury.

The Prince Albert approached us while aground, and Commander Forsyth tendered his assistance; it was not, however, required. Soon after, the Rescue came in sight from around Beechy island, and making us out in our predicament, hove to in the offing and sent a boat in. She had been up Wellington Channel as far as Point Innes. The condition of the ice prevented her from reaching Cape Hotham, (the appointed place of rendezvous) so she had returned in search of us.

On the 26th, with a light breeze, we passed Beechy island, and ran through a narrow lead to the north. Immediately above Point Innes, the ice of Wellington Channel was fixed and unbroken from shore to shore and had every indication of having so remained for at least two or three years. It was generally about eight feet thick, and the sharp angular hummocks—peculiar to recently formed ice—had been rounded down to gentle hillocks, by the action of the weather for several seasons. Farther progress to the north was out of the question. To the west, however, along the edge of the fixed ice, a lead presented itself, with a freshening wind from the southeast. We ran into it; but at half way across the channel, our headway was arrested by the closing ice. A few miles beyond this, two of the English vessels (one a steamer) were dangerously beset. I deemed it prudent to return to Point Innes, under the lee of which, the vessels might hold to in security until a favorable change should take place.

On Point Innes, distinct traces of an encampment were found, together with many relics similar to those found at Cape Riley. Captain Penny (whose squadron we met here) picked up a piece of paper containing the name of one of the officers of Franklin's expedition, written in pencil; thus proving beyond a doubt that some of his party had encamped here; but when or under what circumstances, it was difficult to say. The preserved meat-cans, moreover, bore the name of the person who had supplied his ships with that article.

On Point Innes we also found the remains of an Esquimaux hut, but it had evidently been abandoned for many years. No recent traces of this people were found on any of the shores of Lancaster sound, that we visited. The weather becoming more favorable, we retraced our steps as far as Beechy island, in order to make more minute investigations in that quarter. The vessels were made fast to the land-ice on the northwest side of the island, on the 27th of August. The schooner Felix, Captain Sir John Ross, R. N., and the squadron under Captain Penny, joined us at this point. Consulting with these gentlemen, a joint search was instituted along the adjacent shore, in all directions. In a short time one of Captain Penny's men returned, and reported that he had discovered *several graves*. On examination, his report proved to be correct. Three well made graves were found, with painted head-boards of wood; the inscriptions on which were as follows:

1st.—"Sacred to the memory of W. Braine, K. M., H. M. S. Erebus, Died April 3d, 1846, aged 32 years. 'Choose ye this day whom you will serve.'"

2d.—"Sacred to the memory of John Hartwell, A. B., H. M. S. Erebus, aged 23 years. 'Thus saith the Lord of Hosts: consider your ways.'"

3d.—"Sacred to the memory of Jno. Torrington, who departed this life, January 1, A. D., 1846, on board H. M. ship Terror, aged 20."

Near the graves were also other unmistakable evidences of the missing expedition having passed its first winter here. They consisted of innumerable scraps of old rope and canvass; the block on which stood the *armorer's anvil*, with many pieces of coal and iron around it: the outlines of several tents, or houses, supposed to have been the sites of the observatory, and erections for sheltering the mechanics. The chips and shavings of the carpenter still remained.

A short distance from this was found a large number of preserved meat-tins, all having the same labels as those found at Point Innes.

From all these indications, the inference could not fail to be arrived at, that the Erebus and Terror had made this their *first* winter quarters after leaving England. The spot was admirably chosen for the security of the ships, as well as for their early escape the following season. Everything, too, went to prove that up to this point the expedition was well organized, and that the vessels had not received any material injury.

Early in the morning of the 28th August, H. B. M. ship Resolute, Captain Austin, with her steam tender, arrived from the eastward. Renewed efforts were made by all parties to discover some written notice, which, according to his instructions, Sir John Franklin ought to have deposited at this place in some conspicuous position. A cairn of stones erected on the highest part of the island was discovered. A most thorough search with crows and picks was instituted at and about it, in the presence of all hands. This search was continued for several days, but not the slightest vestige of a record could be found. The graves were not opened nor disturbed.

Capt. Sir John Ross had towed out from England a small vessel of about 12 tons. He proposed leaving her at this point, to fall back upon in case of disaster to any of the searching vessels. Our contribution to supply her was three barrels of provisions.

From the most elevated part of Beechy island (about 800 feet high,) an extensive view was had both to the north and west. No open water could be seen in either direction.

On the 29th of August we cast off from Beechy island and joined our consort at the edge of the fixed ice, near Point Jones.

Acting Master S. P. Griffin, commander of the Rescue, had just returned from a searching excursion along shore, on which he had been despatched 48 hours before. Midshipman Lovell and four men composed his party. He reports, that pursuing carefully his route to the northward, he came upon a partially overturned cairn of large dimensions, on the beach a few miles south of Cape Bowden. Upon strict examination it appeared to have been erected as a place of deposite for provisions. No clue could be found within it or

around, as to the persons who built it; neither could its age be arrived at. At 2 p. m. of the 28th, he reached Cape Bowden without further discovery. Erecting a cairn containing the information which would be useful to a distressed party, he commenced his journey back.

Until the 3d of September we were detained at this point by the closing in of the ice from the southward, occasioned by strong S. E. winds, accompanied with thick weather and snow. On this day the packed ice moved off from the edge of the fixed ice, leaving a practicable lead to the west, into which we at once stood. At midnight, when about two-thirds of the way across the channel, the closing ice arrested our progress. We were in some danger from heavy masses coming against us, but both vessels passed the night uninjured. In the evening of the 4th we were able to make a few miles more westing, and the following day we reached Barlow's inlet. The ice being impracticable to the southward, we secured the vessels at its entrance. The Assistance, and her steam tender, were seen off Cape Hotham, behind which they disappeared in the course of the day.

Barlow's inlet would afford a good shelter for vessels in case of necessity, but it would require some cutting to get in or out. The ice of last winter still remained in it unbroken.

A fresh breeze from the north on the 8th, caused the ice in the channel to set to the southward. It still remained, however, closely packed on Cape Hotham. On the 9th, in the morning, the wind shifted to the westward; an opening appeared, and we at once got under way.

Passing Cape Hotham, a lead was seen along the south side of Cornwallis island, into which, with a head wind, we worked slowly, our progress being much impeded by bay ice; indeed, it brought us to a dead stand more than once. The following day we reached Griffith's island, passing the southern point of which, the English searching vessels were descried made fast to the ice at a few miles distance. The western lead closing at this point, we were compelled to make fast also.

The ice here was so very unfavorable for making further progress, and the season was so far advanced, that it became necessary to take further movements into serious consideration. A consultation was held with the commander of the Rescue, and after reviewing carefully all the circumstances attending our position, it was judged that we had not gained a point from which we could commence operations in the season of 1851 with decided advantages. Therefore, agreeably to my instructions, I felt it an imperative duty to extricate the vessels from the ice and return to the United States.

The state of the weather prevented our acting immediately upon this decision.

September 11th, wind from the eastward, with fog and snow, we were kept stationary; much bay ice forming; thermometer 26°. Early in the morning of the 12th the wind changed to the N. W. and increased rapidly to a heavy gale, which, carrying off the ice, brought with it clouds of drift snow.

The Rescue was blown from her ice anchors, and went adrift so suddenly that a boat and two of her men were left behind; she got under sail, but the wind was too strong for her to regain the ice. The driving snow soon hid her from us. The Advance came near meeting the same fate; the edge of the floe kept breaking away, and it was with much difficulty that other ice anchors could be planted further in, to hold on by. The thermometer fell to 8°; mean for the 24 hours, 14°.

On the morning of the 13th, the wind having moderated sufficiently, we got under way, and, working our way through some streams of ice, arrived in a few hours at Griffith's island, under the lee of which we found our consort made fast to the shore, where she had taken shelter in the gale, her crew having suffered a good deal from the inclemency of the weather. In bringing to, under the lee of the island, she had the misfortune to spring her rudder, so that, on joining us, it was with much difficulty she could steer. To insure her safety and more rapid progress she was taken in tow by the Advance, when she bore up with a fine breeze from the westward. Off Cape Martyr we left the English squadron, under Capt. Austin.

About ten miles further to the west, the two vessels under Capt. Penny, and that under Sir John Ross, were seen secured near the land. At 8 p. m. we had advanced as far as Cape Hotham. Thence, as far as the increasing darkness of the night enabled us to see, there was nothing to obstruct our progress, except the bay ice. This with a good breeze would not have impeded us much; but, unfortunately, the wind, when it was most required, failed us. The snow, with which the surface of the water was covered, rapidly cemented and formed a tenacious crust, through which it was impossible, with all our appliances, to force the vessels. At 8 p. m. they came to a dead stand, some ten miles to the east of Barlow's inlet.

The following day the wind hauled to the southward, from which quarter it lasted till the 19th. During this period the young ice was broken, its edges squeezed up into hummocks, and one floe overrun by another till it all assumed the appearance of heavy ice. The vessels received some heavy nips from it, but they sustained them without injury. Whenever a pool of water made its appearance every effort was made to reach it, in hopes it would lead us into Beechy island, or some other place where the vessels might be placed in security for the winter.

The winter set in unusually early, and the severity with which it commenced forbade all hope of our being able to return this season, and I now became anxious to attain a point in the neighborhood from whence, by means of land parties in the spring, a goodly extent of Wellington Channel might be examined.

In the mean time, under the influence of the south wind, we were being set up the channel. On the 18th we were above Cape Bowden, the most northern point seen on this shore by Parry. The land on both shores was seen much further, and tended considerably to the west of north. To account for this drift, the fixed ice of Wellington channel, which we had observed in passing to the westward, must have been broken up and driven to the southward by the heavy gale of the 12th.

On the 19th the wind veered to the north, which gave us a southerly set, forcing us in at the same time with the western shore. This did not last long, for the next day the wind hauled again to the south and blew fresh, bringing the ice in upon us with much pressure. At midnight it broke up all around us, so that we had work to maintain the Advance in a safe position and keep her from being separated from her consort, which was immovably fixed in the centre of a large floe.

We continued to drift slowly to the N. N. W. until the 22d, when our progress appeared to be arrested by a small low island which was discovered in that direction, about seven miles distant. A channel of three or four miles in width separated it from Cornwallis island. This latter island, tending N. W. from our position,

terminated abruptly in an elevated cape, to which I have given the name of "Manning," after a warm personal friend and ardent supporter of the expedition. Between Cornwallis island and some distant high land visible in the north, appeared a wide channel leading to the westward. A dark misty-looking cloud which hung over it, (technically termed "frost-smoke") was indicative of much open water in that direction.

This was the direction to which my instructions, referring to the investigations at the National Observatory, concerning the winds and currents of the ocean, directed me to look for open water.

Nor was the open water the only indication that presented itself in confirmation of this theoretical conjecture as to a milder climate in that direction. As we entered Wellington channel, the signs of animal life became more abundant, and Captain Penny, commander of one of the English expeditions, who afterwards penetrated on sledges much farther towards the region of the frost-smoke than it was possible for us to do in our vessels, reported that he actually arrived on the borders of this open sea.

Thus these admirably drawn instructions, deriving arguments from an enlarged and comprehensive system of physical research, not only pointed with emphasis to an unknown open sea, into which Franklin had probably found his way, but directed me to search for traces of his expedition in the very channel at the entrance of which it is now ascertained he had passed his first winter.

The direction in which search, with most chances of success, is now to be made for the missing expedition, or for traces of it, is no doubt in the direction, which is so clearly pointed out in my instructions.

To the channel which appeared to lead into the open sea, over which the cloud of frost-smoke hung as a sign, I have given the name of Maury, after the distinguished gentlemen at the head of our National Observatory, whose theory with regard to an open sea to the north is likely to be realized through this channel. To the large mass of land visible between N. W. to N. N. E. I gave the name of Grinnell, in honor of the head and heart of the man in whose philanthropic mind originated the idea of this expedition, and to whose munificence it owes its existence.

To a remarkable peak bearing N. N. E. from us distant about forty miles, was given the name of Mount Franklin. An inlet or harbor immediately to the north of Cape Bowden was discovered by the commander of the Rescue, in his land excursion from Point Innes, on the 27th of August, and has received the name of Griffin inlet. The small island mentioned before was called Murdaugh's island, after the acting master of the Advance.

The eastern shore of Wellington channel appeared to run nearly parallel with the western; but it became quite low, and being covered with snow, could not be distinguished with certainty, so that its continuity with the high land to the north was not ascertained.

Some small pools of open water appearing near us, an attempt was made to get the vessels into them. The Advance was moved about fifty yards, but our combined efforts were of no avail in extricating the Rescue from her icy cradle. A change of wind not only closed the ice up again, but threatened to give us a severe nip. We unshipped her rudder and placed it out of harm's way.

September 23d was an uncomfortable day; the wind was from the N. E. with snow. From an early hour

in the morning the floes began to be pressed together with so much force that their edges were thrown up in immense ridges of rugged hummocks. The Advance was heavily nipped between two floes, and the ice was piled up so high above the rail on the starboard side as to threaten to come on board and sink us with its weight. All hands were occupied in keeping it out. The pressure and commotion did not cease till near midnight, when we were very glad to have a respite from our labors and fears. The next day we were threatened with a similar scene, but it fortunately ceased in a short time.

For the remainder of September and until the 4th of October, the vessels drifted but little. The winds were very light; the thermometer fell to minus 12° and ice formed over the few pools in sight, sufficiently strong to travel upon.

We were now strongly impressed with the belief that the ice had become fixed for the winter, and that we should be able to send out travelling parties from this advanced position for the examination of the land to the northward. Stimulated by this fair prospect, another attempt was made to reach the shore in order to establish a depot of provisions at, or near Cape Manning, which would materially facilitate the progress of our parties in the spring, but the ice was still found to be detached from the shore, and a narrow lane of water cut us off from it.

During this interval of comparative quiet, preliminary measures were taken for heating the Advance, and increasing her quarters so as to accommodate the officers and crews of both vessels. No stoves had as yet been used in either vessel; indeed they could not well be put up without placing a large quantity of stores and fuel upon the ice. The attempt was made to do this, but a sudden crash in the floe where it appeared strongest, causing the loss of several tons of coal, convinced us that it was not yet safe to do so. It was not till the 20th of October that we got fires below. Ten days later the housing-cloth was put over, and the officers and crew of the Rescue ordered on board the Advance for the winter. Room was found on the deck of the Rescue for many of the provisions removed from the hold of this vessel; still a large quantity had to be placed on the ice.

The absence of fires below had caused much discomfort to all hands ever since the beginning of September; not so much from the low temperature as from the accumulation of moisture, by condensation, which congealed as the temperature decreased, and covered the wood-work of our apartments with ice. This state of things soon began to work its effect upon the health of the crews; several cases of scurvy appeared among them; and notwithstanding the indefatigable attention and active treatment resorted to by the medical officers, it could not be eradicated; its progress, however, was checked.

All through October and November we were drifted to and fro by the changing wind, but never passed out of Wellington Channel. On the first of November the new ice had attained the thickness of thirty-seven inches; still, frequent breaks would occur in it, often in fearful proximity to the vessels. Hummocks, consisting of massive granite-like blocks, would be thrown up to the height of twenty, and even thirty feet. This action in the ice was accompanied with a variety of sounds impossible to be described; but when heard, never failed to carry a feeling of awe into the stoutest hearts. In the stillness of an arctic night they would be heard several miles; and often was the rest of all hands disturbed by them.

To guard against the worst that could happen to us, the destruction of the vessels, the boats were prepared, and sledges built. Thirty days' provisions were placed in them for all hands, together with tents and blanket bags for sleeping in. Besides this each man and officer had his knapsack, containing an extra suit of clothes. These were all kept in readiness for use at a moments notice.

For the sake of wholesome exercise, as well as to innure the people to ice travelling, frequent excursions were made with our laden sledges. The officers usually took the lead at the drag-ropes, and they, as well as the men, underwent the labor of surmounting the rugged hummocks with great cheerfulness and zeal. Notwithstanding the low temperature, all hands usually returned in a profuse perspiration. We had also other sources of exercise and amusement, such as the foot-ball, skating, sliding and racing, with theatrical representations on holidays and national anniversaries. These amusements were continued throughout the winter, and contributed very materially to the cheerfulness and general good health of all hands.

The drift had set us gradually to the southeast until we were about five miles to the southwest of Beechy island. In this position we remained comparatively stationary about a week. We once more began to entertain a hope that we had become fixed for the winter, but it proved a vain one; for on the last day of November a strong wind from the westward set in, with thick snowy weather. This wind created an immediate movement in the ice; several fractures took place near us, and many heavy hummocks were thrown up. The floe in which our vessels were embedded was being rapidly encroached upon, so that we were in momentary fear of the ice breaking from around them, and that they would be once more broken out, and left to the tender mercies of the crushing floes.

On the following day (the first of December,) the weather cleared off, and the few hours of twilight which we had about noon enabled us to get a glimpse of the land. As well as we could make it out, we appeared to be off Gascoigne inlet.

We were now clear of Wellington Channel, and in the fair way of Lancaster Sound, to be set either up or down at the mercy of the prevailing winds and currents. We were not long left in doubt as to the direction we had to pursue. The winds prevailed from the westward, and our drift was steady and rapid towards the mouth of the sound.

The prospect before us was now anything but cheering. We were deprived of our last fond hope—that of becoming fixed in some position whence operations could be carried on by means of travelling parties in the spring. The vessels were being fast set out of the regions of research.

Nor was this our only source of uneasiness. The line of our drift was from two to five miles from the north shore; and whenever the moving ice met with any of the capes, or projecting points of land, the obstruction would cause fractures in it, extending off to, and far beyond us.

Cape Hurd was the first and most prominent point; we were but two miles from it on the 3d of December. Nearly all day the ice was both seen and heard to be in constant motion at no great distance from us. In the evening a crack in our floe took place not more than twenty-five yards ahead of the Advance. It opened in the course of the evening to the width of one hundred yards.

No further disturbance took place until noon of the 5th, when we were somewhat startled by the familiar and unmistakable sound of ice grinding against the side of the ship. Going on deck, I perceived that another crack had taken place along the length of the vessel. It did not open more than a foot; this, however, was sufficient to liberate the vessel, and she rose several inches bodily, having become more buoyant since she was frozen in. The following day, in the evening, the crack opened several yards, leaving the sides of the Advance entirely free, and she was once more supported by, and rode in her own element. We were not, however, by any means in a pleasant situation. The floes were considerably broken in all directions around us, and one crack had taken place between the two vessels. The Rescue was not disturbed in her bed of ice.

December 7, at 8 a m., the crack in which we were had opened and formed a lane of water 50 feet wide, communicating ahead, at the distance of 60 feet, with ice of about one foot in thickness, which had formed since the 3d. The vessel was secured to the largest floe near us, (that on which our spare stores were deposited.) At noon the ice was again in motion, and began to close, affording us the pleasant prospect of an inevitable "nip" between two floes of the heaviest kind. In a short time the prominent points took our sides on the starboard, just about the main rigging, and on the port, under the counter, and at the fore rigging, thus bringing three points of pressure in such a position that it must have proved fatal to a larger or less strengthened vessel.

The Advance, however, stood it bravely. After trembling and groaning in every joint, the ice passed under and raised her about two and a half feet; she was let down again for a moment, and then her stern was raised about five feet; her bow, being unsupported, was depressed almost as much. In this uncomfortable position we remained. The wind blew a gale from the eastward; and the ice all round was in dreadful commotion, excepting, fortunately, that in immediate contact with us. The commotion in the ice continued all through the night, and we were in momentary expectation of witnessing the destruction of both vessels. The easterly gale had set in some two or three miles to the west.

As soon as it was light enough to see on the 9th, it was discovered that the heavy ice in which the Rescue had been embedded for so long a time, was entirely broken up and piled around her in massive hummocks. On her pumps being sounded, I was gratified to learn that she remained tight, notwithstanding the immense straining and pressure that she must have endured.

During this period of trial, as well as in all former and subsequent ones, I could not avoid being struck with the calmness and decision of the officers, as well as the subordination and good conduct of the men, without an exception. Each one knew the imminence of the peril that surrounded us, and was prepared to abide it with a stout heart. There was no noise, no confusion. I did not detect, even in the moments when the destruction of the vessels seemed inevitable, a single desponding look among the whole crew; on the contrary, each one seemed resolved to do his whole duty, and everything went on cheerily and bravely.

For my own part I had become quite an invalid—so much so, as to prevent my taking an active part in the duties of the vessel, as I had always done, or even from incurring the exposure necessary to proper exercise. However, I felt no apprehension that the vessel would not be properly taken care of, for I had perfect

confidence in the officers, one and all, by whom I was surrounded. I knew them to be equal to any emergency; but I felt under special obligations to the gallant commander of the Rescue, for the efficient aid which he rendered me. With the kindest consideration, and most cheerful alacrity, he volunteered to perform the executive duties during the winter, and relieve me from every thing that might tend in the least to retard my recovery.

During the remainder of December, the ice remained quiet immediately around us, and the breaks were all strongly cemented by new ice. In our neighborhood, however, cracks were daily visible. Our drift to the eastward averaged nearly six miles per day, so that on the last of the month we were at the entrance of the sound; Cape Osborn bearing north from us.

January, 1851. On passing out of the sound and opening Baffin's bay to the northward, was seen a dark horizon, indicating much open water in that direction.

On the 11th, a crack took place between us and the Rescue, passing close under our stern. It opened and formed a lane of water eighty feet wide. In the afternoon the floes began to move; the lane of water was closed up, and the edges of the ice coming in contact with much pressure, threatened the demolition of the narrow space which separated us from the line of fracture; fortunately the floes again separated and assumed a motion by which the Rescue passed from our stern to the port bow, and increased her distance from us to seven hundred yards, where she came to a stand. Our stores that were on the ice were on the same side of the crack as the Rescue, and of course were carried with her.

The following day the ice remained quiet; but soon after midnight on the 13th, a gale having sprung up from the westward, it once more got into violent motion; young ice in the crack near our stern was soon broken up; the edges of the thick ice came in contact, and a fearful pressure took place, forcing up a line of hummocks which approached within ten feet of our stern. The vessel tumbled and complained a great deal. At last the floe broke up around us into many pieces and became detached from the sides of the vessel. This scene of frightful commotion lasted till 4 a. m. Every moment I expected the vessel would be crushed or overwhelmed by the massive ice forced up far above our bulwarks. The Rescue, being further removed on the other side of the crack from the line of crushing, and being firmly embedded in heavy ice, I was in hopes would remain undisturbed; but this was not the case; for, on sending to her as soon as it was light enough to see, the floe was found to be broken away entirely up to her bows, and then formed into such high hummocks, that her bowsprit was broken off, together with her head, and all the light wood-work about it. Had the action of the ice continued much longer, she must have been destroyed.

We had the misfortune to find that sad havoc had been made among the stores and provisions left on the ice; a few barrels were recovered, but a large number were crushed and had disappeared.

On the morning of the 14th, there was again some motion in the floes; that on the port side moved off from the vessel two or three feet, and there became stationary. This left the vessel entirely detached from the ice round the water-line, and it was expected she would once more resume an upright position. In this, however, we were disappointed, for she remained with her stern elevated and a considerable list to starboard,

being held in this uncomfortable position by the heavy masses which had been forced under her bottom.—She retained this position until she finally broke out in the spring.

We were now fully launched into Baffin's bay, and our line of drift begun to be more southerly, assuming a direction nearly parallel with the western shore of the bay at a distance of from forty to seventy miles from it.

After an absence of eighty-seven days the sun, on the 29th of January, raised his whole diameter above the southern horizon and remained visible more than an hour. All hands, on seeing an old friend again, gave vent to their delight in three hearty cheers.

The length of the days now went on increasing rapidly, but no warmth was yet experienced from the sun's rays; on the contrary the cold became more intense. Mercury was congealed for several days in February; also in March; which did not occur at any other period of the winter. A very low temperature was invariably accompanied with clear and calm weather, so that our coldest days were perhaps the most pleasant. In the absence of wind we could take exercise in the open air without feeling any inconvenience from the cold. But with a strong wind blowing it was dangerous to be exposed to its chilling blasts for any length of time, even when the thermometer indicated a comparatively moderate degree of temperature.

The ice around the vessel soon became again cemented and fixed, and no other rupture was experienced until it finally broke up in the spring and allowed us to escape. Still we kept driving to the southward along with the whole mass. Open lanes of water were visible at all times from aloft; sometimes they would be formed within a mile or two of us.

Norwhales, seals, and dovekeys, were seen in them. Our sportsmen were not expert enough to procure any except a few of the latter, although they were indefatigable in their exertions to do so. Bears would be frequently seen prowling about, but only two were killed during the winter; others were wounded, but made their escape. A few of us thought their flesh very palatable and wholesome, but the majority utterly rejected it. The flesh of the seal, when it could be obtained, was received with more favor.

As the season advanced, the cases of scurvy became more numerous; yet they were all kept under control by the unwearied attention and skilful treatment of the medical officers. My thanks are due to them, especially to passed assistant surgeon Kane, the senior medical officer of the expedition. I often had occasion to consult him concerning the hygien of the crew, and it is in a great measure owing to the advice which he gave and the expedients which he recommended, that the expedition was enabled to return without the loss of a man.

By the latter part of February, the ice had become sufficiently thick to enable us to dig a trench around the stern of the Rescue, deep enough to ascertain the extent of the injury she had received in the gale at Griffith's island. It was not found to be material; the upper gudgeon alone had been wrenched from the stern-post; it was adjusted and the rudder repaired and made ready for shipping when it should be required. A new bowsprit was also made for her out of the few spare spars that we had left, and everything made sea-worthy in both vessels before the breaking up of the ice.

On the first of April a hole was cut in some ice that had been forming since our first besetment, in September; it was found to have attained the thickness of seven feet two inches.

In this month (April) the amelioration in the temperature became quite sensible. All hands were kept at work cutting and sawing the ice from around the vessels, in order to allow them to float once more. With the Rescue, they succeeded, after much labor, in attaining this object; but around the stern of the Advance, the ice was so thick that our thirteen-feet saw was too short to pass through it. Her bows and sides, as far aft as the gangways, were liberated.

After making some alterations in the Rescue for the better accommodation of her crew, fires having been lighted on board of her for several days previous, to remove the ice and dampness which had accumulated during the winter, both officers and crew were transferred to her on the 24th of April. The stores of this vessel which had been taken out were restowed, the housing-cloth taken off, and the vessel made in every respect ready for sea. There was little prospect, however, of our being able to reach this desired element very soon. The nearest water was a narrow lane more than two miles distant, and to cut through the ice which intervened would have been next to impossible. Beyond this lane from the mast-head nothing but interminable floes could be seen. It was thought best to wait in patience and allow nature to work for us; she alone could effectually break up and dissolve the icy chains with which she had bound us.

In May, the noon-day sun began to have some effect upon the snow which had covered the ice; the surface of the floes became watery and difficult to walk over; still, the dissolution was so slow in comparison with the mass to be dissolved, that it must have taken us a long period to have become liberated from this cause alone. More was expected from our southerly drift, which still continued, and must soon carry us into a milder climate and open sea.

On the 19th of May the land about Cape Searle was made out, the first we had seen since passing Cape Walter Bathurst, about the 20th of January. A few days later we were off Cape Walsingham, and on the 29th passed out of the Arctic zone.

June 5th, a moderate breeze from S. E. with pleasant weather; thermometer up to 40° at noon, and altogether quite a warm and melting day. During the morning, a peculiar crackling sound was heard on the floe; I was inclined to impute it to the settling of the snow-drifts, as they were acted upon by the sun; but in the afternoon, at about five o'clock, the puzzle was solved very lucidly, and to the exceeding satisfaction of all hands. A crack in the floe took place between us and the Rescue, and in a few minutes thereafter the whole of the immense field in which we had been embedded for so many months was rent in all directions, leaving not a piece exceeding 100 yards in diameter. This rupture was not accompanied with any noise.

The Rescue was entirely liberated; the Advance only partially; the ice in which her after-part was imbedded, still adhered to her from the main chains aft, keeping her stern elevated in its unsightly position. The pack (as it may now be called) became quite loose; and but for our pertinacious friend acting as an immense drag upon us, we might have made some headway in any desired direction. All our efforts were now turned to getting rid of it. With saws, axes, and crow-bars, the people went to work with a right good will, and after hard labor for 48 hours succeeded. The vessel was again afloat, and she righted. The joy of all hands vented itself spontaneously in three hearty cheers. The after part of the false keel was gone, being carried

away by the ice. The loss of it, however, I was glad to perceive, did not materially affect the sailing or working qualities of the vessel. The rudders were shipped, and we once more were ready to move as efficient as the day we left New York.

Steering to the S. E. and working slowly through the loose but heavy pack, on the 9th we parted from the Rescue, in a dense fog, she taking a different lead from the one the Advance was pursuing.

On the morning of the 10th, with a fresh breeze from the north, under a press of sail, we forced a way into an open and clear sea, in latitude 65° 30′, about 35 miles from the spot in which we were liberated.

The wind, which in the ice was merely fresh, proved to be in clear water a gale, with a heavy sea running. Through this we labored until the next morning, when it moderated. The coast of Greenland was in sight.

Our course was now directed for the Whale Fish islands (the place of rendezvous appointed for our consort) which we reached on the 16th; not, however, without having some difficulty in getting through the unusual number of bergs which lined the coast. In an encounter with one we lost a studding-sail boom.

I had two objects in visiting these islands—that of verifying our chronometers, and to recruit our somewhat debilitated crews. The latter object, I learned on arriving, could be much better attained, and the former quite as well, at Lively, on Disco island, for which place I bore up, leaving orders for the Rescue to follow us. We arrived on the 17th, and the Rescue joined us the day after.

The crews were indulged with a run on shore every day that we remained, which they enjoyed exceedingly after their tedious winter's confinement. This recreation, together with a few vegetables of an anti-scorbutic character that were obtained, was of much benefit to them. There were no fresh provisions to be had here at this season of the year. Fortunately one of the Royal Danish Company's vessels arrived from Copenhagen while we remained, and from her we obtained a few articles that we stood much in need of. The company's store was nearly exhausted, but what remained was kindly placed at our disposal.

On the 22d, our crews being much invigorated by their exercise on *terra firma*, and the few still afflicted with scurvy being in a state of convalescence, we got underway with the intention of prosecuting the object of the expedition for one season more at least.

From the statements made to us at Lively, the last winter had been an extraordinary one. The winds had prevailed to an unusual degree from the N. W., and the ice was not at any time fixed. The whaling fleet had passed to the northward some time previous to our arrival.

On the 24th we met with some obstruction from the ice off Hare island, and on the following day our progress was completely arrested by it at Stovöe island. In seeking for a passage, we got beset in the pack on a lee shore, near to which we were carried by the drifting ice, and narrowly escaped being driven on the rocks. After getting out of this difficulty, we availed ourselves of every opening in the ice, and worked slowly to the northward near the shore.

On the 1st of July we were off the Danish port and settlement of Pröven; and as the condition of the ice rendered farther progress at present impossible, we went in and anchored, to wait for a change.

Here, again, some scurvy grass was collected, and the men allowed to run on shore.

On the 3d we got underway, and ran out to look at the ice; but finding it still closely packed, returned to our anchorage.

On the 6th, the accounts from our look-out on a hill near us were more favorable. Again we got underway, and finding the "pack" somewhat loose, succeeded in making some headway through it. The following day we got into clear water, and fell in with two English whaling vessels, the Pacific and the Jane. To their gentlemanly and considerate commanders, we are much indebted for the supplies furnished us, consisting of potatoes, turnips, and other articles most acceptable to people in our condition. Much interesting news was also gained from them respecting important events which had occurred since we had left home.

Their statement as to the condition of the ice to the northward, was anything but flattering to our prospects. They had considered it so very unfavorable, as to abandon the attempt to push through Melville bay, and were now on their way to the southward.

On the 8th we communicated with the settlement of Uppernavik. The next day two more English vessels were passed on their way to the southward. At the same time, the McLellan, of New London, the only American whaler in Baffin's bay, was descried, also standing south. On communicating with her, we were rejoiced to find letters and papers from home, transmitted by the kindness of Mr. Grinnell.

We remained by the McLellan several hours, in order to close our letters and despatch them by her. Several articles that we stood much in need of were purchased from her.

On the 10th, the Baffin islands being in sight to the north, we met the remainder of the whaling fleet returning. They confirmed the accounts given us by the Pacific and the Jane, in regard to the unfavorable condition of the ice for an early passage through Melville bay. The following are the names of the vessels communicated with, viz: Joseph Green, of Peterhead; Alexander, of Dundee; Advice, of do.; Princess Charlotte, of do.; Horn, of do.; Anne, of Hull; Regalia, of Kirkaldy; Chieftain, of do.; and Lord Gambier, of ——. My notes are unfortunatety at fault as to the names of their enterprising and warm-hearted commanders, each of whom vied with the other in showering upon us such articles as they knew we must be in want of, consisting of potatoes, turnips, fresh beef, &c. My proposition to compensate them they would not entertain for a moment, and I take this occasion of making public acknowledgment of the valuable aid rendered us, to which, no doubt, much of our subsequent good health is owing.

On the 11th, in attempting to run between the Baffin islands, the Advance grounded on a rocky shoal. The Rescue barely escaped the same fate by hauling by the wind, on discovering our mishap. Fortunately there was a large grounded berg near, to which our hawsers could be taken for hauling off, which we succeeded in doing after twenty-four hours' hard work. The vessel had not apparently received any injury; but a few days later, another piece of her false keel came off, supposed to have been loosened on this occasion.

The ice to the north of these islands was too closely packed to be penetrated, and the prevalence of southerly winds afforded but little prospect of a speedy opening.

On the 16th the searching yacht Prince Albert succeeded in reaching near to our position, after having been in sight for several days. Mr. Kennedy, her commander, came on board and brought us letters.

The berth in which our vessels were made fast at this place was alongside of the low tongue of an immense berg, which by accurate measurement, towered up to the height of 245 feet above the water-level. It was aground in 96 fathoms water, thus making the whole distance from top to bottom 821 feet; its diameter at the water-line I estimated at 1,500 feet. We saw many bergs equally as large as this, and some much larger; but this was the only one that we had so good an opportunity of measuring with accuracy.

On the 17th the ice opened a little, and we got underway. Hence till the 27th, with almost incessant work, by watching every opening we continued to make a few miles each day, the Prince Albert keeping company with us. On this day, while running through a narrow lead, the ice closed suddenly. The Advance was caught in a tight place, and pretty severely nipped. We managed to unship the rudder; but before it could be secured, the crushing ice carried it under: we had lines fast to it, however, and after the action of the ice ceased, it was extricated without injury. The Rescue and Prince Albert, although near us, were in better berths, and escaped the severe nip which the Advance received. We were closely beset in this position, and utterly unable to move until the 4th of August, when, the ice slacking a little we succeeded in getting hold of the land-ice, one mile further to the north. The Prince Albert was still in the "pack," a mile or two to the southward of us. Mr. Kennedy informed me that it was his intention to abandon this route and return to the southward as soon as his vessel could be extracted from her present position, in the hope of finding the ice more practicable in that direction. Some letters and papers that he had brought out for the other English searching vessels, he placed on board of us; unfortunately we were never able to deliver them.

We lost sight of the Prince Albert on the 13th. For our own part there was no possibility of moving in any direction. The berth we had taken up under the impression that it was a good and safe one, proved a "regular trap;" for the drift pack not only set in upon us, but innumerable bergs came drifting along from the southward, and stopped near our position, forming a perfect wall around us at not more than from 200 to 400 yards distance. Many unsuccessful attempts were made to get out. The winds were light, and all motion in the ice had apparently ceased. The young ice, too, began to form rapidly, and was only prevented from cementing permanently together the broken masses around us, by the frequent undulations occasioned by the overturning or falling to pieces of the neighboring bergs.

My anxiety daily increased at the prospect of being compelled to spend another winter in a similar, if not a worse situation than was that of the last.

On the 18th the ice was somewhat looser; we immediately took advantage of it, and managed to find an opening between two large bergs sufficiently wide to admit the passage of the vessels. Outside of the bergs, we had open water enough to work in.

We stood to the N. W., but the lead closing in the distance, and the ice appearing as unfavorable as ever, I did not deem it prudent to run the risk of their besetment again at this late period of the season. And considering that, even if successful in crossing the pack, it would be too late to hope to attain a point on the route of search as far as we had been last year, therefore, in obedience to that clause in my instructions which says, "You are especially enjoined not to spend, if it can be avoided, more than one winter in the Arctic

regions," with sad hearts that our labors had served to throw so little light upon the object of our search, it was resolved to give it up and return to the United States.

We therefore retraced our steps to the southward. The ice that had so much impeded our progress upward, had entirely disappeared. We touched for refreshments by the way, at some of the settlements on the coast of Greenland, where we were most kindly and hospitably received by the Danish authorities.

Leaving Holsteinberg on the 6th of September for New York, the two vessels were separated in a gale to the southward of Cape Farewell. The Advance arrived on the 30th ultimo, and the Rescue on the 7th inst., with grateful hearts from all on board to a kind and superintending Providence for our safe deliverance from danger, shipwreck and disaster, during so perilous a voyage.

I have the honor to be, sir, your obedient servant,

EDWIN J. DE HAVEN,

Lieutenant Commanding Arctic Expedition.

To the Hon. WILLIAM A. GRAHAM,

Secretary of the Navy, Washington.

P. S.—The chart with my track, and which also shows the discoveries of the expedition, has been deposited in the Hydrographical office.

I have thought these documents possessed interest, perhaps value enough, in their bearings upon this open sea which now appears to be attracting so much attention, to entitle them to a place here. At any rate I hope they will not be considered as altogether out of place in such a work as this is.

The Cruise of the "Taney."

By an act of Congress, approved March 3d, 1849, the Secretary of the Navy was authorized to assist me in the undertaking to investigate the phenomena of the winds and the waves, to find short routes, and to discover matters of importance to Commerce and Navigation. The following is the joint resolution which expressed the wishes of Congress in the matter.—

"SECTION 2. *And be it further enacted,* That the Secretary of the Navy be directed to detail three 'suitable vessels of the navy in testing new routes and perfecting the discoveries made by Lieut. Maury in 'the course of his investigations of the winds and currents of the ocean; and to cause the vessels of the navy 'to co-operate in procuring materials for such investigations, in so far as said co-operation may not be incom-'patible with the public interest: *Provided,* That the same can be accomplished without any additional 'expense."

But one vessel has been detailed for this service, and she unfortunately proving utterly unseaworthy, her cruise was broken up before it was half completed.

The U. S. Schooner "Taney," Lieut. J. C. Walsh commanding, was the vessel, and her unfitness for such service is the more to be regretted, as her officers one and all, entered upon this field of research with so much spirit.

The "Taney," well equipped for the duties assigned her, sailed from New York in October, 1849, with the following instructions issued from the Navy Department:

"The object of the service upon which the 'Taney' has been detailed, is to make observations upon the winds and currents of the sea, and to collect other facts in connection with the 'Wind and Current Charts' of Lieut. Maury, and which are of practical importance to the safe navigation of the seas, or to the study of the phenomena of the ocean. This is an important service. It is a service which requires patient and laborious observations from the officers entrusted with it.

"A faithful record of every phenomenon observed, with a full statement of all the circumstances as to time, place, &c., connected with it, is of great importance.

"It is expected, therefore, that you and the officers of the 'Taney,' will bestow upon the duty which has been assigned yourself and them, because of a peculiar fitness therefor, the utmost diligence and the most assiduous attention.

"The subjects of observation which will command your particular attention, are:

"1st, The force and direction of the wind, the hourly state of the weather, and all the meteorological conditions connected therewith, as thermal, dynamical, barometrical, and the like.

"2d, The force and set of currents, their depth and width, their temperature and the position of their edges or limits.

"3d, Hourly observations upon the temperature of the surface water.

"4th, Frequent observations upon the temperature of the ocean at various depths.

"5th, Deep-sea soundings.

"6th, Vigias, and all dangers about which there are doubts, either as to existence or position.

"7th, Transparency and saltness, or the specific gravity of sea water, in the different parts of the ocean.

"You will determine the specific gravity of the water, either by one of the hydrometers, or the specific gravity bottle furnished for the purpose.

"You will keep an abstract of your log as per form. It is believed that the form itself is sufficiently explicit as to what is wanted for the abstract, a copy of which you will send to Lieut. Maury, as often as you have an opportunity, returning the original to him when you arrive in the United States.

"You will make it a rule, the better to ascertain rate of currents and fix their limits, to determine by observation the variation of the compass and your position in the forenoon, in the afternoon and at night, as well as at noon, whenever the weather will permit; and after allowing for lee-way, heave of the sea, variation of the compass, and the false steerage, you will call the difference between the place of the vessel as established by observation, and as established by *dead reckoning*, current, and so to enter it in the abstract.

"You will also try in calms, and as often as convenient, both for surface and under currents, in the usual way, by lowering boats, letting down weights, &c.

"For longitude by chronometer at night, the planets, or the largest of the fixed stars are the best objects to be observed when the horizon is good—the Mer. Alt. of the moon may be used for latitude at night, or in the fore or afternoon, according to its age.

"Note in its proper column, not only the portion of cloudy sky, 10 being entirely overcast, and 0 clear; but state also the direction or directions in which the clouds are moving, with the kinds of clouds, as Nimb. Cum., Cirrus Stratus, &c.

"In taking temperature of surface water, a fresh bucket should be drawn up each time, the thermometer plunged into it immediately, held there for several minutes, and *read while the bulb is in the water.*

"For the purpose of ascertaining the existence of under currents, you will sound at intervals, at the least of every 30 miles, with 100 fathoms line, if there be as much depth, attaching to the line two thermometers, one near the lead, and the other 50 fathoms from it. In case you have no thermometers suitable, or should lose them, then you will attach two hollow non-conducting cylinders with valves opening upward, in the place of the thermometers, haul the line up briskly, and try quickly the temperature of the water brought up in the cylinders.

"In case you should find an under current, you will endeavor to ascertain its limits and set with all the accuracy possible. For rate and direction, a block of wood, or a barrega loaded just to sinking, and suspended at any required depth by a small float just sufficient to keep it from sinking further, will perhaps be the best means.

"The determination of the rate and set of under currents is an operation which is so modified by the weather and other circumstances, that it must of necessity be left, in a great measure, to the judgment and mental resources of the operators. The officers of the "Taney" will perhaps have abundant opportunity to display their ingenuity with regard to the subject. The lead used in sounding for temperatures should be painted white, and the distance at which it disappears going down and reappears coming up should be entered in fathoms in the transparency column.

"The 'Taney' will be provided with the means of sounding at great depths. It is desirable to reach the bottom at every attempt, for the depth of the ocean is an important element towards a perfect understanding of the tides, their laws of motion, the course and form of the tidal wave and the like.

"At the distance of every two hundred miles across the ocean, soundings must be made all the way, both going and returning, with the view to reach the bottom and determine the depth of the sea. The "Taney," has been provided with the necessary apparatus therefor. In each case the lead must be armed, the specimens of the bottom which it may bring up must be preserved in a bottle, with a lable attached showing the date, place and the depth. The time selected for these soundings should be calm weather, when the sea is smooth, and when there is a likelihood of its so continuing for several hours at least. In hauling up the sounding line from great depths, care should be taken to prevent the lead from having too great an upward motion, lest by turning around it should twist the line in two. Therefore in hauling it up frequent pauses should be made to allow the line to untwist. It is desirable, also, to have specimens of water from the greatest depths.

"In going across the Atlantic, and in looking after the vigias and doubtful dangers to which your attention will also be called, it will be most convenient for you to take up your position for deep sea-soundings in the calm regions known as the "horse latitudes," which in the month of October will be found between the parallels of 24° and 25° N., according to longitude; you will see the limits of this calm belt sufficiently marked and developed on series B, of Maury's Wind and Current Chart, with copies of which the 'Taney' will be supplied.

"A series of accurate barometrical observations in this belt of calms will be of exceeding interest and value. It is one of the nodes in the general system of the atmospherical circulation of the earth. Here the winds from the polar, meet in the upper regions, those from the equatorial calms, and they so nearly balance each other as to produce almost a perpetual calm. We may then look under this meeting of opposing winds for an accumulation of atmosphere, and consequently for an increased barometrical pressure, and from this increase of pressure accurately determined, may be derived an expression to show the total amount or value of those physical forces which are exerted to put and keep the trade winds in motion. You will therefore be diligent with the barometer in those regions, and in all others, taking care, when it is mounted on board, to note in the Abstract Log its distance from the level of the sea.

"The 'vigias,' and dangers of doubtful existence or position which you will look after, are Ashton's Rock, about latitude 35° 50′ N., longitude 71° 48′ W., said to be 8 feet above the water, and to have been seen in 1824. False Bermudas, about latitude 32° 37′ N., longitude 58° 37′ W. They are rocks, said to be frequently mistaken for the Bermudas, they are laid down in a part of the ocean but little frequented.

Nye's Rock, - - - -	31°	15′	N. Lat.	Long.	55°	41′	W.
Van Kuelen's Vigia, - - -	31	40	"	"	38	10	"
Josyna Rock. - - - -	31	45	"	"	23	40	"
Steen's Ground, - - - -	32	30	"	"	21	15	"

"You will touch at one of the Canaries for water. Without unnecessary delay, you will proceed thence towards the Cape Verds, examining as you go the position of Mary's Rock, Bom Felix Shoal, the Bonetta Rocks, and the reef to the west of them, marked on Maury's chart as doubtful with regard to position.

"The route, so far as it has been indicated to you, will take you through the Sargasso sea. You will be careful to try the depth, and the temperature of the water of that sea, and to note the latitude and longitude of its edges where you cross it.

"Besides the regular series of deep-sea soundings, you are requested to make frequent use of the lead (deep-sea) in the vicinity of all "vigias" and "rocks" that are supposed to lie in your way; for if they exist, you will probably find shoaler water in their vicinity.

"After completing this service, you will put into Port Praya for water and provisions. Filling up with these, and allowing your crew and officers a few days to refresh, you will again put to sea; standing to the southward, and examining as you go Warley's Shoal and French Shoal of 1796; the supposed place of both of which are marked on the charts of Lieut. Maury.

"From the last-named shoal you will proceed to a supposed submarine volcanic region of considerable extent, between the equator and 3° south latitude, and between 15° and 25° west longitude. Through all parts of the ocean you will continue as you go, the regular series of observations as to winds, currents, temperatures, soundings, &c., as per form of Abstract Log.

"In passing the region of equatorial calms, you will again cross one of those atmospherical nodes under which nice barometrical observations become of exceeding interest.

"After having satisfied yourself as to the characteristics with regard to depth and bottom in that part of the ocean just alluded to as probably volcanic, you will proceed to make Cape St. Roque, bestowing unremitted attention to the soundings and temperatures as you go.

"There seems to be reason to suppose that an under-current of warm water has its genesis in this part of the ocean; soundings and deep-sea temperatures across the Southern Atlantic may throw some light upon this important question.

"Arriving off Cape St. Roque, and having put into some convenient port of Brazil for water, if necessary, you will proceed to make a zig-zag course along the coast to the northward, for the purpose of investigating the currents thence to the mouth of the Amazon. You will make stretches off from the coast of one hundred miles, or as far as it may be necessary, in order to cross and define the system of currents and counter-currents that are supposed to prevail there, and a correct knowledge of which is so essential to the speedy and safe navigation of that part of the ocean.

"Having satisfied yourself as to those currents, you will proceed homeward by the following route:—from the equator in long. 37° W., draw a straight line to Cape Charles. This line will lay nearly in the middle of a strip of the ocean about 300 miles broad, and which is remarkable for the temperature of its water. You will sail a zig-zag course through this strip, crossing it at least four times on your way home, and passing the line which you are directed to draw, at least two hundred miles on either side, and taking deep-sea soundings before you put about to recross it again. Should you discover anything remarkable as to the depth of the sea within this region, you will push the discovery to a conclusion.

"It is expected that you will return to the United States some time in the month of April next.

"As the service on which you are engaged has for its object the making of observations and the collecting of facts *at sea*, you will keep the sea during your absence as long as practicable.

"It is not expected that you will at all times be able to carry on without interruption the series of observations as here laid down for you. It is supposed that they will be interrupted from time to time by the weather and other circumstances. Much, therefore, must be left to your discretion; you understand the nature of the service which is required, and are in possession of the views of the Department on the subject. The Department therefore commits the service to you, feeling assured that you will in all cases exercise a sound discretion, and so meet its just expectations."

Similar instructions have been given to Lieut. S. P. LEE, commanding U. S. Brig Dolphin, now—May 1852—engaged upon the service which was assigned to the "Taney." The complete results of his labors will not probably be received from him in time for the present edition of this work.

Lieut. Walsh, and the officers associated with him, acquitted themselves of the duty thus assigned them, in a manner creditable in the highest degree to them as well as to the profession to which they belong.

The greatest length of sounding line that ever penetrated the depths of the ocean, gives eclat to this cruise of the "Taney," for to her officers belongs the honor of having obtained the greatest sounding ever known.

To them credit is also due for clearing off from the charts of the ocean, the names of various rocks, shoals, and dangers which for years had been causing mariners to turn out of their way; been hindering navigation, interfering with commerce, vexing navigators and discouraging merchants, shippers and owners.

Before his vessel was condemned as unseaworthy, Lieut. Walsh had an opportunity of examining the localities assigned to no less than seven of these great commercial hindrances. He performed this duty in so thorough a manner, as completely to establish their non-existence. Upon the faith of his work, I have been duly authorized to erase the whole seven from the charts. See the list reported by him: pp. 165–6.

The discovery, also, by Lieut. Walsh of a submarine current, of great velocity; of water in the depths of the ocean which when brought to the surface, relieved of pressure and reduced to the surface temperature, was found to be lighter than the surface water;—and that the depth of the North Atlantic ocean probably exceeds six miles and a half in the deepest parts, also adorns the list of interesting results of this highly serviceable cruise.

On November 15th, 1849, in latitude 31° 59′ N., longitude 58° 43′ W., Lieut. Walsh with his sounding wire obtained a cast of 5,700 fathoms = 34,200 feet, or 6.48 miles, without reaching bottom. This is the greatest depth ever attained, and would show that the greatest depths of the ocean exceed the greatest elevations of the land by more than one mile at least. It is very desirable to have this sounding verified.

On the return of the "Taney," Lieut. Walsh did me the honor to communicate to me in writing, the results of his labors during this cruise. Though that letter has been extensively copied in nautical and scientific works, and though it has already had a wide circulation, yet inasmuch as it is a part of the history of this undertaking, I quote it in place.

Lieutenant J. C. Walsh to Lieutenant Maury.

Bordentown, New Jersey, *August* 15*th*, 1850.

Sir,—I have to add to the "Abstract Log" of the U. S. Schooner Taney, which has been sent you, some remarks upon the results of parts of our work there recorded: the explorations in the Atlantic, for some of the many rocks and vigias of doubtful existence—deep soundings with the wire—investigations of currents, particularly the under currents, &c.

The *rocks* and *vigias* searched for, with the positions assigned to them upon the Charts, are as follows:

Ashton Rock - - - -	Lat. 33°50′ N.	Long. 71°40′ W.
False Bermudas - - - -	" 32 30	" 58 40
Nye's Rock - - - -	" 31 15	" 55 50
Vankeulen's Vigia - - -	" 31 40	" 38 20

Josyna Rock - - - -	Lat. 31° 40′ N.	Long. 23° 45′ W.
Steen Ground - - - -	" 32 30	" 21 15
Mary's Rock - - - -	" 19 45	" 20 45

Not one of them was found, nor any indication of their existence; on the contrary, every evidence to disprove it. Our various tracks over and about their reported positions, covering the extent of 1½ degrees of longitude and 40 miles of latitude, with the many and deep soundings, from 100 to 800 fathoms, without getting bottom, will be found sufficient, I trust, to satisfy navigators that they have no existence—or at least, that those parts of the ocean in which they have been reported to exist, are free from all dangers. To the first three mentioned we gave the most thorough search: to Ashton Rock, six days time; to the False Bermudas eight days; to Nye's Rock, likewise eight days. All our tracks were by daylight, as the schooner was always hove to at night, while engaged in these explorations. A slight discoloration of water was noticed in the region assigned to Mary's Rock, but no soundings could be got with 500 fathoms. This rock had been previously searched for with like results, by the U. S. Exploring Expedition, Captain Wilkes; and by H. M. S. Levin, Captain Bartholomew. Ashton Rock is placed in a most frequented part of the ocean; there is not a day that some vessel does not pass in the vicinity, and nothing has been seen of it since the first and only report of it in the year 1824. This fact alone should disprove it, independent of our search. I find Mr. Blunt has erased it from his Chart of the North Atlantic, as also the False Bermudas, Vankeulen's Vigia, Steen Ground and Mary's Rock. There are sufficient real dangers in the Atlantic; these imaginary ones should not disfigure the charts; they only serve to harrass navigators, turn vessels from their routes, and thus injure commerce. The reports of them by merchant vessels, which seldom take time to examine the appearance of such dangers, can be readily explained. Floating wrecks, large trees, carcasses of whales, &c., presenting all the appearance of reefs, have deceived experienced seamen.

Though we did so much less in *deep soundings* in the Atlantic, than expected, owing to the rough weather, bad state of the vessel and loss of so much wire, in the first experiment, nevertheless the proving the ocean to have a depth of more than 5,700 fathoms, (34,200 feet, or more than six statute miles,) as was satisfactorily done in this first trial, is alone of much interest and importance. This vast depth, greater than the elevation of any mountain above the surface, and the greatest depth of the ocean ever yet measured, was reached, without finding bottom, in latitude 31° 59′ N., longitude 58° 43′ W., on November 15th, 1849. The wire broke at this length, 5,700 fathoms, at the reel, and this large portion of our supply was thus so early lost. It preserved the exact plumb line thoughout the sounding; there was a steady, uniform increase of weight and tension; no check whatever any instant of its descent,—which proved that it could not have touched bottom before the break.* It had been very carefully measured and marked, so that the *ocean here is deeper than*

* The lead used was but 10 lbs. weight, with a Stellwagen cone fitted to it. Nothing else was attached to the wire but a small instrument (weighing about 6 lbs.) invented by yourself, for indicating the depth reached: I had tested this several times to considerable depths, and found its indications correct. Our arrangements for these deep soundings were altogether very complete. It may be well to add an account of them. We had on board 14,300 fathoms of wire, weighing 3,025 lbs., all of the best English steel, of five different sizes,

5,700 *fathoms*, can be relied upon as accurate. This great sounding is within 32 miles of the assigned position of the rocks, called the False Bermudas, for which we were then in search, which fact alone should go far to disprove them. We had three choice chronometers, two of which performed with rare excellence throughout the cruise, and being a beautiful, clear day, a number of sets of observations were taken in the morning, noon, and afternoon, so that the position was determined with the nicest accuracy. It proved the finest possible day for this work, the sea so smooth and hardly a breath of wind. Though we found by trial in the morning a slight surface drift, setting to W. S. W., there was no change of position during the sounding, as proved by the observations; the great weight and extent of the wire, penetrating to such profound depths, seemed to serve as an anchor to keep the little schooner steady.

In all our subsequent work under this head, I found the heave of the sea, however slight, was the great difficulty—the lifting of the stern in the pitching motion causing such an immense increase of strain upon the wire, breaking it upon almost every occasion on reaching about 2,000 fathoms. It is only under the most favorable circumstances, when the sea is very unusually smooth, that this mode of measuring its vast central depths can succeed.

The next subject to which I would refer, is our investigations of the *under currents* of the ocean. I regret we had so few opportunities for these very interesting experiments; but enough has been done to seem to warrant the conclusion, that these under-currents are *generally* stronger, setting in various different directions, than those of the surface. I am well aware that there is no mode of testing their *exact* velocity; but that practised by myself, which I will describe, was certainly all-sufficient to show their relative velocity. There may be none so rapid as that mighty oceanic river, the *Gulf Stream:* unfortunately, the weather prevented our making these investigations in that interesting region; but in the various parts of the Atlantic in which we succeeded in these experiments, on only two occasions did we find the under-current of less velocity than that running in a different direction above it. The following is the mode practised in testing them:

Nos. 5, 7, 8, 10, and 13 (Birmingham gauges.) Every part was tested to bear at least one-third more than the weight which it was calculated to sustain.

An extent of 7,000 fathoms of this, weighing 1,800 lbs. (the remaining 7,300 fathoms, composed of the smaller sizes, Nos. 10 and 13, being stowed away as spare wire,) carefully measured and marked with small copper labels, was linked into one piece, and wound upon an iron cylinder, 3 feet in length and 20 inches in diameter,—the largest-sized wire being wound first, so as to be uppermost in sounding. Two swivels were placed near the lead, and one at each thousand fathoms, to meet the danger of twisting off by the probable rotary motion in reeling up. The cylinder with the wire was fitted to a strong wooden frame, and machinery attached—fly-wheel and pinions, to give power in reeling up. Four men at the cranks could reel up with ease, with the whole weight of wire out. Iron friction bands, which proved of indispensable importance, were connected to regulate the rate of the wire in running off the reel. One man with his hand upon the lever of one of these friction bands could preserve a uniform, safe velocity, checking or stopping the wire as required. The whole apparatus could be taken apart, and stowed away in pieces (being so large and massive, this was indispensable in so small a vessel as the Taney.) When wanted for use, the frame was put together, and secured to the deck by iron clamps and bolts, near amidships, the reel hoisted up from below, and shipped in its place; a *fairleader* was secured to the taffrail, being a thick oak plank, rigged out five feet over the stern, having an iron pulley, 18 inches diameter, fitted in its outer end, and two sheet iron fenders 3½ feet long, of semi-circular shape, fitted under it, to guard the wire from getting a short nip in the drifting of the vessel. The wire was led aft, from the reel, over the pulley which traversed freely in the fairleader, and passed between these fenders into the water.

The time occupied in the descent of *the* 5,700 *fathoms*, at the moderate rate it was allowed to go off the reel, using the friction bands, was exactly 1½ hours. I found in the subsequent soundings, that two or three men could reel up 1,000 fathoms in 2½ hours, taking time to rub dry and oil it in passing to the reel, to guard against rust.

J. C. W.

The surface current was first tried by the usual mode (a heavy iron kettle being lowered from a boat to the depth of 80 fathoms); then, for the trial of the under current, a large *chip-log*, of the usual quadrantal form, the arc of it measuring full four feet, and heavily loaded with lead to make it sink and keep upright was lowered by a light but strong cod-line to the depth of 126 fathoms, (the length of the line); a barrega was attached as a float, a log-line fastened to this barrega, and the rate of motion of this float, as measured by this log-line and the glass, and the direction as shown by a compass, were assumed as the velocity and set of the under-current. No allowance was made for the drag of the barrega, which was always in a different direction from the surface current. It was wonderful, indeed, to see this barrega move off against wind and sea, and surface current, at the rate of over one knot an hour, as was generally the case, and on one occasion as much as 1¾ knots. The men in the boat could not repress exclamations of surprise, for it really appeared as if some monster of the deep had hold of the weight below and was walking off with it. I will cite from the Log several instances of these experiments.

On May 11th, in lat. 24° 43′ N., long. 65° 25′ W., we found a surface current of one-third knot per hour setting to the West, and an under current, at the depth of 126 fathoms, of one knot, setting W. S. W.—temperature of water at surface 77.3°, at 50 fathoms 77.5°, at 100 fathoms 73.5°. The current felt by the vessel on that day (as deduced from the comparison of the true positions obtained by astronomical observations and chronometers, with those by the dead-reckoning) agreed with this trial of the surface current, being the same within a fraction, viz: 0.3 knot, westerly. On this day, as noted in the "Column of Remarks," the sea was covered by a species of *medusæ*, of a dark-red color, spherical in shape, from one-eighth, to three-eighths inch in diameter.

On May 12, at 4 P. M., in lat. 25° 55′ N., long. 64° 43′ W., the surface current was found to be ¼ knot setting N. N. E., and the under current (at 126 fathoms) 1¾ knots, setting S. E., being the strong under current I have alluded to: this was well ascertained by several trials—temperature of water at surface 75°, at 50 fathoms 76°, and at 100 fathoms 69°. From this time, 4 P. M. to 8 A. M., the following morning, we experienced a strong current of 1.3 knot per hour, setting N. 14° E., as determined by the observations. While trying the currents in the boat, all hands remaining on board the schooner were employed sounding with 500 fathoms line, but failed to get the temperature at that depth, there being at the time too much swell.

On May 13th, at 5*h*. 30*m*. P. M., in lat. 26° 42 N., long. 64° 4′ W., the surface current was found to be ¼ knot setting E. by S., the under-current (at 128 fathoms) 1½ knots setting W. S. W.; at same time obtained the following temperatures: at surface 77.5°, at 50 fathoms 76.5°, at 100 fathoms 74.5°, at 500 fathoms 53°. The current felt by the schooner in the interval from 8 A. M. to 4 P. M., was easterly 0.4 knot per hour, agreeing with the trial in the boat.

On May 14th, in lat. 26° 45′ N., long. 63° 53′ W., found a slight surface drift, too small to be measured, setting to the westward, and an under current (at 126 fathoms) of 1¼ knots, setting N. by E. No current had acted on the vessel for the preceding 16 hours, the dead-reckoning agreeing with the observations.

On this day, the sea being pretty smooth, we tried soundings, and with the wire got 1,050 fathoms

without bottom, and we succeeded in getting, by one of the Syx's self-registering thermometers, (which came up uninjured by the immense pressure,) the temperature at that great depth, which was 49°, while at the surface it was 77°.

On 18th May, at 9 A. M., in latitude 30° 6′ North, longitude 67° 56′ West, found a surface current of one-third knot, setting N. W. by N., and a very slight under current (at 126 fathoms) not more than one sixth knot, setting N. E. No current was felt by the vessel during that day, but during the preceding night one-fourth knot per hour, setting N. W. Being calm and pretty smooth, we sounded during this day to the depth of 2,050 fathoms, when the wire broke without reaching bottom. The temperature at surface 70°, at 100 fathoms 65°. The trial of currents on this day was one of the two occasions which I have alluded to, on which we found a less under current than that above it.

On 29th May, at 11 A. M., in latitude 33° 59′ N., longitude 72° W., found the surface current one-third knot, setting S. E., and an under current (at 126 fathoms) of one knot, setting W. N. W.; temperature at surface 71°, at 50 fathoms 70.5, at 100 fathoms 67°. We were set during this day, as determined by the afternoon observations, to the eastward, at the rate of one-half knot per hour. On this, which happened to be the last occasion of these experiments, I tried the current at the depth to which the kettle was lowered (80 fathoms,) which it would have been better to have always done; I found it tended in the same direction as that at 126 fathoms, (counter to the surface current,) but at so small a rate that it could hardly be measured, not more than $\frac{1}{10}$ knot per hour, the float moving at only this small rate, being but one-tenth of the velocity at which it had moved just before when trying at 126 fathoms. This indicates that the kettle had just penetrated the under current; and thus, by this means, it would appear practicable to measure the depth of the surface current, or its point of contact with the counter under current. Such experiments in the *Gulf Stream* would be particularly interesting.

In connection with this subject of under currents, or *submarine streams*, I may hope that you will find our record of the temperatures of the ocean, taken, according to instructions, at every 30 miles, to the depths of 100 and of 50 fathoms, and the surface temperatures taken every hour, may serve to throw more light in this new world of research, of such great interest and importance in terrestrial physics.

The column of currents in the abstract log, gives the currents of practical importance to navigation, those of the *surface* for every eight hours, or as often as ascertained by the observations; the difference between the true position, as determined by them, and that deduced from the log or dead-reckoning, being held as the effect of current. Our dead-reckoning was with this view kept with unusual care and nicety. I found the night observations could not be depended upon sufficiently to determine currents, but the early morning or evening twilight often afforded beautiful opportunities—the horizon so well defined, and the larger planets and stars so clear and brilliant. You will notice we met with the usual variable currents in crossing the North Atlantic in about latitude 31°, region of variable winds: between the longitudes, however, of 48° and 57° we met with a steady current of about one knot an hour, setting to the northward and westward. Recrossing, in about latitude 17°, we experienced daily the great *equatorial stream* setting to the westward, at the average of half a knot

per hour. This is within the region of the *trade winds*—and here we often noticed the upper light clouds, the *cirri*, moving from the westward, while the lower strata moved with the prevailing winds from the eastward, thus indicating the existence of an upper current of winds counter to the *trades*.

We first crossed the *Gulf Stream* on the 31st October; we struck into it in latitude 37° 22′ N., longitude 71° 26′ W., as indicated by the temperatures of the water, which were as follows:

8 A. M.	water	at surface	66°,	air	54°
9	"	"	" 73°,	"	53°
10	"	"	" 76°,	"	55°
11	"	"	" 77°,	"	56°

Making a S. S. E. course good at the rate of six knots per hour. 77° was the highest temperature found in the stream in crossing it this time. We were set by it to the eastward, at the rate of 3.6 knots per hour. We got out of it, judging from the water getting back to 70°, in latitude 36° 16′ N., longitude 70° 56′ W., bearing from the point of entrance S. 20° E., distant 71 miles. This 71 miles would, therefore, appear the breadth between those points of latitude and longitude; no doubt, however, the surface breadth varies considerably, as also the *velocity*, affected by the winds and other causes unknown. We encountered the usual bad weather, and suffered much in our little craft from a very heavy, irregular, and topling sea, which kept the decks flooded. I extract from the column of "Remarks" on that day: "Oct. 31st—*On Western edge of Gulf Stream*—from 4 A. M. to 8 A. M., fresh with heavy squalls, accompanied by thunder, lightning, *hail*, *snow*, rain, and appearances of waterspouts; columns of dense vapor rising from the sea to the clouds," &c. "The same bad weather continued throughout the day. From 8 to midnight, hail with rain, accompanied by squalls and a tremendous sea."

Recrossing this *stream* on our return, on May 30th, we entered it in latitude 35° 30′ N., longitude 72° 35′ W., having a slight touch of the same weather, "squalls with rain, thunder and lightning." The temperature stood as follows:

	Water at surface.	Water at 50 fathoms.	Water at 100 fathoms.	Air.
8 A. M.	71.8°	71.8°	67°	70°
9 "	73			
10 "	75.5			
11 "	78.5			
12 "	78.5	77.5	72.5	76

79° was the highest temperature found, when at the same time it was 77° at 50 fathoms, and 74° at 100 fathoms. Its velocity, as felt by us in crossing this time, was 2.5 knots per hour, setting N. 77° E. We got out of it in latitude 36° 42′ N., longitude 72° 10′ W., bearing from the point of entrance N. 16° E., distant 78 miles: 78 miles, therefore, appears the breadth between these points of latitude and longitude.

The temperatures, on leaving it, stood as follows, the air being 66°:

3 A. M., water at surface 78°.

4 A. M., water at surface 74°, at 50 fathoms 70°, at 100 fathoms 64°.

5 A. M., water at surface 72°.

6 A. M., water at surface 71°.

Heading during these three hours N. W. by N., at the rate of three and a half knots an hour. At 9 A. M. the water stood at surface 69.5°, at 50 fathoms 65.5°, at 100 fathoms 65.5°. By 1 P. M., the temperature at surface had fallen to 63.5°, at 50 fathoms to 58.5°, at 100 fathoms 58°, the temperature of the air being 68°.

When on soundings next day, June 1st, in latitude 39° N., longitude 70° 30′ W., the water showed as low as 51° at surface, and maintained an average temperature of 53° until we reached New York. This is a difference of 28° from the adjacent Gulf Stream. Shoals of porpoises and black fish were seen by us in the hot waters of the stream. We saw very little Gulf or sea weed (fucus natans) in it, but much at its outer edge. While mentioning this weed I may here remark, that we looked in vain, in the region assigned to the *Sargasso sea*, for the great fields of it which have been reported. Small patches of five or six feet, generally arranged in long parallel lines in the direction of the wind, were seen daily in crossing the Atlantic till we reached the longitude of 28° when it disappeared altogether. My frequent examinations of this weed satisfy me that, wherever it may originally come from, it feeds and grows upon the waters of the sea, which is certainly not more strange than the plant which feeds upon the air.

We discovered the *hot waters of the Gulf Stream* extending as far east as 72° 10′ in a latitude so far south as 33° 30′. The column of water temperatures in the "Abstract" from May 23d to 29th, while engaged in the search for Ashton rock, will satisfy you of this interesting and important fact; for you will notice that whenever we reached that longitude, in our various tracks between the latitudes 33° 30′ and 34° North, we experienced a sudden change of as much as 5° and 6° in the surface temperature—70° to 76°. This must be a branch or offset from the Gulf Stream, being so far to the eastward of the limits hitherto given to it *in those latitudes*. We first noticed this extraordinary change of temperature on the 23d—the temperature of surface water rising on that day from 71.5° to 79°. I cite from the Abstract:

Midnight, commencing 23d May, latitude 32° 35′ North, longitude 73° 24′; surface water 71.5°, at 50 fathoms 71.5°, 100 fathoms 67°.

8 A. M., latitude 32° 58′ North, longitude 73° 36′, surface water 73°.

9 A. M., latitude 32° 50′ North, longitude 73° 38′, surface water 75°, at 50 fathoms 73.5°, 100 fathoms 70°.

3 P. M., latitude 33° 03′ North, longitude 73° 52′, surface water 79°.

The current at 6 A. M. was found by trial to be one knot per hour, setting W. N. W., and the under current (at 126 fathoms) one knot, setting to the E.; the current felt by the vessel (as determined by comparison of results of observation and dead-reckoning) was 1.5° knot per hour, setting westerly; this was between 8 A. M. and 4 P. M. The variations of temperature of the water, recorded on the next day, (24th of May,) in latitude 33° 25′, longitude 72° 40′, are worthy of notice—the sudden fall of 3½ degrees in one

hour, from 6 to 7 P. M., 75.5° to 72°, while standing to the northward and eastward, and the rise again the next hour to 75°, made me suspect the possibility of a *shoal*, so that I put back, found the place again, and sounded with 300 fathoms line, but got no bottom. It being thick squally weather, we could not attempt deeper soundings.

The column of *specific gravity* of sea-water calls for some remarks. Our measurements by the hydrometer show that in some parts, if not in most parts of the ocean, the water is specifically *lighter* at depths than at surface, when reduced to like temperature—the correction for this difference being applied. I found on one occasion the following large difference: On December 8th, at surface 1028.6, (distilled water as standard held at 1000,) at 200 fathoms 1028.4; at 500 fathoms 1027.2, all at 60° temperature: this was in latitude 31° 42′ North, longitude 38° 12′ W. The specific gravity generally found at surface appears about 1028.4 at 60° temperature; and this specific gravity at surface appears, according to our record, more variable than at depths.

The greatest *transparency* of the water observed, as found in its column, was seventeen fathoms, being able to see a large lead painted white, at that depth. This was in latitude 21° 4′ N., longitude 66° 36′ W.

The column of *barometer* contains the records of the improved marine mercurial barometer, got from Tagliabue, in New York, which proved to be an excellent instrument, and most valuable to me, never failing to warn of an approaching gale. The Aneroid, though not noticed in the "Abstract," was regularly recorded in the Log, with the Mercurial, every four hours during the cruise. This may serve as a good test of its performance. It was set with the Mercurial on leaving New York in October. It commenced at once to differ, indicating higher; and though its daily fluctuations agreed well, this difference steadily increased until, by the time we got back to New York, seven months after, it had reached as high as six-tenths of an inch above it; thus acquiring an error of very nearly one-tenth of an inch a month. This leads me to doubt whether this ingenious instrument can ever be sufficiently trusted to take the place of the Mercurial, though so much to be desired.

The observations for the *variation of the compass* could be taken but seldom with exactness, and therefore appear but seldom in the "Abstract," the needle being generally kept by our jumping little schooner in too unsteady a state for correct azimuths.

In conclusion, I must express my regrets that the most important part of the "Instructions" was prevented being carried out by the bad condition of the schooner, proving, on overhauling at Porto Praya, quite unseaworthy. I allude to the investigations of the currents about Cape St. Roque, and of the volcanic region of the South Atlantic near the equator. But I sincerely trust that the work will not be allowed to stop here—that it will be continued under your instructions, in connection with your "*Wind and Current Charts*," as has been authorized by Congress. The employment of three suitable vessels was recommended by the bill; but one has yet been employed, and that quite unsuitable in size and condition. A vessel of but one hundred tons, as is the "Taney," independent of being too unstable for the observations and the soundings, cannot carry officers and men enough for the incessant and laborious work required, nor provisions and water enough to keep the sea for long periods of time, as is essential on this service."

What the greatest depth of the ocean may be, has ever been a matter of speculation among philosophers, an object of longing desire and curious inquiry among mariners.

Many questions of deep interest touching the physical condition of our planet are connected with the depths of the sea.

The basin of the Atlantic ocean separates the Old World from the New; it is a long channel, with some conformity of outline along its opposite shores. The basin or trough in which those waters are held, extends from the Antarctic to the Arctic seas, perhaps from pole to pole. What is the depth of this trough?

The tides attain their greatest rise and fall as their waves roll, or rather undulate from South to North through this deep and narrow channel.

Do the tides rise higher upon the borders of this sea than elsewhere, because its channel is deeper, or its depths freer than the depths of other seas are from obstructions to the tidal wave?

This great marine trough lies between the Andes and South America on one hand, and the mountains of Africa on the other—each range shooting forth its peak far beyond the limits of perpetual snow. Is the bed of the Atlantic depressed in proportion to these elevations—and is that proportion in an increased or diminished ratio? Nothing that relates to the physical condition of our planet can be without interest, and knowledge with regard to every feature of the Earth, sea or air, is profitable.

It is wise to seek for it, for the ways of nature are the paths of wisdom, and whoever seeks to tread in them is profitted, both he and his generation, by the mere attempt.

The bottom of the Atlantic ocean, indeed, I might say, the bottom of what the sailor calls "blue water," is, with here and there an exception, all over the world, as unknown to us as is the interior of the other planets of our system.

Astronomers have measured the volume, and weighed the masses of those distant spheres. But neither the curiosity, nor the explorations, nor the researches of man have ever succeeded in penetrating farther than a few feet into the crust of our planet.

From the top of the Himalaya to the depth of Lieutenant Walsh's great sounding in the "Taney" would measure in a vertical line, about 12 miles. Before this sounding was taken, the vertical reach of the deepest cast of the plummet at sea, added to the perpendicular elevation of the highest mountain on the land, measured only about ten miles.

What the capacity of those reservoirs which contain the waters that perform such an important part in the economy of the terrestrial arrangement may be, is certainly a matter of inquiry as profitable, as instructive and as useful as the delineation on our maps of mountain ranges and other configurations of the Earth's surface.

Therefore, in this undertaking to collect physical data that we may from them gain knowledge as to the phenomena displayed by the air and the ocean, the subject of deep sea soundings did not escape the attention of an enlightened government wisely administered.

Congress had given the Secretary of the Navy authority to have deep sea soundings made by our men-of-war wherever they go; and to employ the armed cruisers of the government as they pass to and fro about their

business to collect materials for the great work I have in hand. The first attempt to penetrate the depths of the ocean encouraged further exertions: Lieutenant Walsh's deep sea sounding invested the subject with renewed interest, and when it was officially brought to the notice of the lamented Commodore Warrington, the Chief of Bureau of Ordnance and Hydrography, and of his successor, Commodore Morris, under whose orders I am, they both at once gave it their hearty approval and official sanction.

The following circular order to the commanders of all vessels of the Navy was thereupon issued:

Circular.

BUREAU OF ORDNANCE AND HYDROGRAPHY, *Nov.* 22, 1851.

SIR: Your attention is particularly invited to the accompanying directions relative to deep sea soundings.

You will take care that they be diligently and faithfully carried out on board the vessel under your command.

You will report, from time to time, to this Bureau, the latitude, longitude, depth, drift, time, and all the circumstances connected with each cast, whether successful in reaching bottom or not—stating the kind of sinker used, its weight, and whether the large or small twine was used.

This order is to supersede that of June 1st, 1850, on the same subject, and the directions given at pages 70 and 71 of Maury's 3d edition of Sailing Directions, so far as they may conflict with these.

Respectfully, your obedient servant,

C. MORRIS,

Chief of Bureau.

APPROVED: WILL. A. GRAHAM,

Secretary of the Navy.

To———

Directions for taking Deep Sea Soundings, prepared by the Bureau of Ordnance and Hydrography, under the authority of the Secretary of the Navy.

For the purpose of ascertaining the depth of the sea, and determining the shape of the great oceanic basins, every vessel in the Navy will be provided with a quantity of twine and leads, or instead of the lead a round 32-pdr. shot may be used.

The twine furnished to each vessel is of two kinds. The smaller is on reels of 10,000 fathoms to a reel; it is capable of bearing a weight of 70 lbs.; it is marked at every 1,000 fathoms with white (saddler's) silk, one knot standing for 1,000 fathoms. These lengths are subdivided by marks at every 200* fathoms. The 200 and 400 fathom mark between every 1,000, being of red silk; and the 600 and 800 each of black.

For the knots and round turns by which the 200, the 400, the 600 and 800 fathoms are told, officers are referred to the twine on the reel, and the marks themselves.

The smaller twine is to be used when the depth and other circumstances appear unfavorable for recovering the lead.

*It has been found most convenient to mark every 100 fathoms.

The larger twine is capable of bearing a weight of 150 lbs. 5,000 fathoms of it are furnished to every ship, on a reel of multiplied motion, capable of reeling up quickly, and of recovering the line and lead, when the depth is not over 1,000 or 2,000 fathoms, and when other conditions are favorable for so doing.

To sound, take advantage of calms or of good weather, when the sea is not rough, and when the drift of the ship will not be rapid, and sound from the weather gangway, or from a boat lowered for the purpose. Let the shot or lead take the twine as fast as it will, as the chip does the log line, and carefully note the time as the line goes out, by the 400, the 600 and the 1,000 fathom marks.* Note also the drift, and every circumstance connected with the operation, and enter them upon the log, stating in every instance of loss, the quantity of twine lost, and the quantity remaining on the reel.

Unless it be in parts of the ocean where soundings have before been made, and where there is reason to believe that the depth is less than 5,000 fathoms, it is not desirable to attempt to sound with less than that quantity of small twine on the reel.

For further information upon the subject, officers are referred to the chapter on Deep Sea Soundings, 3d† edition Maury's Sailing Directions.

It is not desirable to have soundings repeated about those places at which bottom has already been reported in that work.

Vessels bound round either Cape Horn or the Cape of Good Hope, will economise their sounding materials until they reach the parallel of Rio de Janeiro. Deep sea soundings off those capes and beyond, in the Indian ocean, on the one hand, and to both the South and North Pacific on the other, are much desired.

Two or three more lines of soundings across the Carribean sea and Gulf of Mexico, to cross the "Albany's" soundings, are also particularly desired.

When the large twine is used, as it may be gradually, when near the land, and as it is supposed it may also frequently be done upon the open sea, both in the Indian and Pacific oceans, it should be armed, and the specimens brought from the bottom, put in a phial, carefully labelled, with the depth, the latitude, and longitude, and returned to the Bureau of Ordnance and Hydrography, but not through the *mail*.

The directions and General Order of June 1st, 1850, are hereby revoked, so far as they conflict with these, as are the directions inserted in Maury's Sailing Directions, 3d edition, pages 70 and 71†.

The "Albany's" deep sea Soundings.

The U. S. Ship "Albany," Commander Chas. T. Platt, was among the first vessels equipped for this interesting service. Her cruising ground was the West India station. Her commander and the officers on board entered heartily into the spirit of deep sea soundings, and have been unceasing in their attention to them.

* It has been found most convenient to time each 100 fathom mark as it goes out. It is also best to sound from a boat.

† Vide other parts of this work for full information and explanations upon the subject of deep sea sounding.

Here, therefore, the American Navy has afforded to it a fine opportunity for solving one of the interesting physical problems of the day, by ascertaining the depth and shape of the basin which holds the waters of the Gulf of Mexico, and of the Carribean sea.

This problem is now, it is hoped, in a fair way of being solved at least so far as to enable us to form a general idea not only as to the depths of this arm of the sea, but as to the depths of the ocean generally.—Many valuable results have already been attained.

In searching for one thing in the domains of physics, we are often rewarded by finding others of more or less value, which were not included in the original design. And so it has been here.

The "Albany," besides ascertaining the depth out in "blue water" of the Gulf of Mexico, will probably ascertain also in what parts of it, under currents exist, and in what parts they do not; and this system of research has already afforded grounds for the hope that it may lead also to the discovery of those secret channels through which the general system of oceanic circulation is kept up.

The twine furnished the "Albany" for this service, unfortunately proved too weak. The best size and the proper strength for the twine to be used were points which experiment alone could determine. That furnished the "Albany" measured about 150 fathoms to the lb., and she had 40,000 fathoms of it. It was intended to be strong enough to bear a weight of 50 or 60 lbs.

And though the sailor resources and ingenuity of Capt. Platt and Lt. Wm. Rodgers Taylor, the executive officer of the ship, finally overcome, in a great measure, as will appear from their reports, these difficulties, yet this could not be accomplished until a large portion of the twine had been lost in experiment.

The twine when used for sounding was wound on a delicately constructed reel, which would turn with as little friction and to the least force, possible. The usual sounding weight was a 32 lb. shot. When the shot was cast overboard, it was allowed to take the line as fast as it would—as in heaving the log, the chip is allowed to take the line;—and the time occupied by the shot in taking out the line was from the first carefully noted.

Now it is evident, the line being always of one size, and the weight a 32 lb. shot of the same form, that these soundings and observations would soon afford us the means of determining, with some degree of approximation at least, the law of descent which would govern a 32 lb. shot sinking in sea water, and drawing after it this particular line.

Having determined from the mean of a number of unexceptionable observations the law of the descent for still water, it would then be practicable, to determine in each instance, whether the sounding had been made through an under current of water or not; and whether the shot had reached the bottom or not.

Suppose the sounding to be made through an under current—what would be the effect? After the shot had passed through this current, this current would be operating upon the *bight* of the line: e. g., in towing vessels when the bight of the tow-line gets in the water, every sailor knows how great is the power which requires to get the line straight again.

In the case of the sounding line, the force exerted by the under current is a *swigging* force, and supposing the shot to be stationary on the bottom, and the ship at rest on the top of the sea, the current will take the twine off from the reel at double its own velocity nearly.

Now if the time occupied by each 100 fathoms in running out were to be noted at every sounding, we should be furnished not only with the means of determining with some degree of probability, at what depth this under current is encountered, but we should have the means of determining its velocity also; and except in those cases where the velocity of the current happens to be that of half the rate at which the shot was sinking just before reaching the bottom, we shall likewise have data for determining what rates are due the shot and what the current, and consequently whether bottom be reached or no.

Lieutenant Taylor has kindly promised when the new line, of which a fresh supply of 40,000 has been ordered, reaches the "Albany," to have it marked at every 100 fathoms, and to note at every sounding, the time it requires the shot to take out successively as it goes down, every 100 fathoms.

I am permitted by Commodore Warrington to quote Capt. Platt's reports to him upon the subject of these interesting experiments.

Captain Platt to Commodore Warrington.

U. S. Sloop of War "Albany," Harbor of St. Thomas, Island of St. Thomas,

December 18th, 1850.

"Sir:—In conformity with your instructions, I have the honor to report the results of our attempts at deep sea soundings.

Our *first* sounding, made with the line provided by the Department for that purpose, and a thirty-two pound shot attached, was attempted on the 6th of December, in lat. 38° 38′ North, and long. 66° 31′ West, both by dead reckoning. At this time, bottom* was found with 1,625 fathoms of line which ran out in 27 minutes.

On the 7th and 8th of December, the weather was too rough to admit of sounding.

On the 9th of December, being by dead reckoning in lat. 33° 34′ North, and long. 61° 38′ West, we found bottom* with 1,950 fathoms of line, running out in one hour and three minutes, with a drift of one mile. On this day, six shots were lost in unsuccessful efforts, the line parting with the heaving of the ship. A bar of iron, weighing 12 pounds, was also tried without success. The result was at last obtained by means of a bar of lead, weighing 13 pounds.

On the 10th of December, no sounding was attempted in consequence of the rough weather.

On the 11th of December, our *third* and *fourth* soundings were effected. The *former* was taken in latitude, by observation, 30° 05′ North, and longitude by chronometer, 58° 12′ West, with 1,000 fathoms* of line, running out in eleven minutes. The *latter* sounding was made in observed latitude 29° 58′ North, and longitude 58° 48′ West, with 1,500* fathoms of line running out in twenty-eight minutes. The former sounding was effected under a light breeze, and the latter in a dead calm, during which the ship had no perceptible drift. Eleven shots were expended before the soundings of this day were secured.

* Further experiments satisfied Captain Platt that he did not get bottom on any one of these occasions.—M. F. M.

On the 12th of December, after lying to for two hours, nothing was accomplished. Five experiments were made with an oiled line, running out respectively 600, 20, 300, 550, and 200 fathoms. Two experiments were also made dispensing with the oil, the sixth shot for the day being lost at a depth of 200 fathoms. The seventh and last sounding for the day was made with three bars of iron lashed together, and having an aggregate weight of twelve pounds. The line parted near the reel, after 1,000 fathoms had been run out.

Our time until the 16th was spent in waxing the twine preparatory to other experiments. On this day, in observed latitude 21° 34′ North, and longitude by chronometer, 63° 23′ West, the line ran out in 28 minutes, and parted at 1,600 fathoms.

This is the extent of our experiments, and the best results we have been able to attain. I am convinced, from the frequent parting of our line under such various circumstances, with reduced tension, at such different lengths, with equal strain, and with repeated marks of fracture in the strands, that the twine furnished was not suitable for our use. If the knots had been well fastened, and the strength of the line equal in all its parts, results more satisfactory to ourselves and more valuable to others might have been obtained.

I have reason to commend the perseverance and scientific skill with which these experiments have been prosecuted by Lieut. Taylor. I am confident that every effort within our power was made by him to render these soundings as complete and accurate as the materials furnished us would warrant.

Since discovering the defectiveness of the line, and observing its liability to fracture, especially at great lengths, I have been suspicious that in no case we had reached the bottom, although the cessation of the strain upon the line had been regarded as indicating a legitimate sounding.

About 14,000 fathoms of the sounding line supplied us yet remain, with which I shall continue experiments at the first opportunity.

Havana, Island of Cuba, January 20th, 1851.—I beg leave (continues Capt. Platt, further) to report the progress of our experiments in deep sea soundings. Subsequently to the attempts reported on the 18th of December, 1850, our next sounding was made on the 29th of the same month, in latitude 17° 54′ North, and longitude, by chronometer, 67° 28′ West,—being below the Mona Passage, midway between the west end of Porto Rico and Mona Island. The line used on this occasion was waxed, and the sounding was made without once severing it; 1200 fathoms of line were run out in 17 minutes, with a drift of about one-half a mile. The temperature of the air 81°, and of the water 84°.

On the 4th of January, 1851, being becalmed in going out of St. Domingo, soundings were found with a vertical line of 370 fathoms, the ship lying about nine miles from land,—latitude 18° 30′ North, longitude 69° 41′ West. Temperature of the air 80°, and of the water 82°. The line ran out in five minutes. It was waxed, and did not part except in the effort to recover the shot.

With a similar line, on the next day, January 5th, at 4 P. M., we found bottom in nineteen minutes, at 1275 fathoms, with about one-half a mile drift. We lay in latitude 17° 16′ North, and longitude 71° 26½′ West, with Altavela in sight. Temperature of the air 82°, and of the water the same.

On the 13th of January, at noon, three unsuccessful attempts at soundings were made with a waxed line,

which parted the first time in two minutes at 250 fathoms, the second time in three minutes at 300 fathoms, and the third time in eighteen minutes at 1200 fathoms. These failures occurred in observed latitude 19° 12′ North, and longitude, by chronometer, 76° 05′ West, with the temperature of the air 83° and of the water 82°.

On the 16th of January, two successful soundings were made,—the former in latitude 22° 29′ North, and longitude 84° 35′ West, at 3.30 P. M., and the latter in latitude 22° 32′ North, and longitude, by chronometer, 84° 32′ West, at 5 P. M. In the former case, the line ran 420 fathoms in five minutes,—in the latter 720 fathoms in eight minutes, with the temperature of the air 82°, and of the water 80°. Between these soundings in which bottom was found, two unsuccessful experiments had been made to verify the first, but in one case, the line parted at 280 fathoms, and in the other case, a squall drove us so rapidly as to render the cast unreliable. All these experiments were made with a waxed line.

From the effect upon the line when bottom was assuredly reached in these experiments, a suspicion has been thrown upon the soundings made before arriving at St. Thomas.

Further experiments I shall endeavor to prosecute, and to report as soon as practicable.

Santiago de Cuba, February 8th, 1851.—I beg leave (to continue) to report the results of soundings made since my communication of the 20th ult.

The first deep sea sounding was made at noon on the 28th of January, in North latitude 24° 05′ and West longitude 82° 05′. Bottom was found with 470 fathoms of line, running out in about six minutes. The temperature of the air 78°, and of the water 80°.

The next day, January 29th, two shots were lost in unsuccessful attempts, the line parting in both instances, once at 280 fathoms, and once 360 fathoms. At a third trial, bottom was found with 500 fathoms of line running out in about six minutes and a half. This sounding was taken in North latitude 24° 37′, and West longitude 79° 48′. I was the more gratified with succeeding in this third attempt, because it had been questioned whether the gradually decreasing velocity of the shot's descent, would not become equal to the velocity of the current in the Gulf Stream, and the line be taken out indefinitely at a consequent speed. It cannot now be questioned that bottom was found, as stated. From the time of these experiments until our arrival on the 2d of February at Cape Haytien, a strong wind and heavy sea rendered soundings impracticable.

On the 6th February, at noon, we sounded during a calm off Cape Haytien. The line ran perpendicularly 640 fathoms in 8 minutes and 45 seconds. Our position by bearings was in latitude 19° 57′ North, and longitude 72° 11′ West. Temperature of the air 82°, and of the water the same.

On the 7th of February, being in the Windward Passage, midway between Cuba and St. Domingo, bottom was reached with 840 fathoms of line, running out in ten minutes and two seconds. I cannot determine, however, what allowance to make for drift on this occasion, nor infer with any certainty the actual depth found at this position. Although in heaving-to for these experiments, sail is always reduced to topsails; yet the unavoidable drift during a strong breeze, materially effects our result, and prevents our giving at the best more than an approximate estimate. Lieut. Taylor, who conducts these experiment quite enthusiastically, will take pleasure in using the first opportunity to make an attempt at sounding from a boat, and ascertain the comparative result.

I should add, that since ascertaining the greater tenacity of the waxed line, we use it altogether in these deep soundings.

I shall continue these experiments on all practical occasions so long as our materials last.

Pensacola—July 15th, 1851.—I have the honor to submit to you the following report of our sounding operations since the 19th April. We have improved every opportunity, but owing to the nature of the service on which the ship has been employed, I am not able to present you with as important results as I could have wished.

April 19th, 1851.—Latitude 23° 21′ North, longitude 82° 44′ West, got bottom with 995 fathoms, waxed line, time of running 16 minutes, 48 seconds. Temperature air 79°, temperature water 80°. On this occasion it was quite calm, and the line ran down perpendicularly, the sea being so smooth we were enabled to let the shot take the line off the reel, without attempting to pay it out, as we usually do, when there is any motion, this accounts perhaps for the length of time the shot occupied in descending.

April 20th, 1851.—Off the Tortugas, dropped a shot overboard expecting to find shoal water, but I was somewhat surprized to find only 21 fathoms. The line proving very strong, the shot was hauled up from that depth and secured. I mention this circumstance only to show you that some parts of the line furnished are of excellent quality.

April 21st, 1851.—Latitude 25° 19′ North, longitude 83° 41′ West, got bottom in 52 fathoms with the patent lead. Temperature air 82°, temperature water 78°.

April 22d, 1851.—Latitude 26° 43′ North, longitude 84° 41′ West, got bottom in 137 fathoms. Temperature air 79°, temperature water 78°.

April 23d, 1851.—Latitude 29° 12′ North, longitude 86° 01′ West, got bottom in 152 fathoms. Temperature air 76°, temperature water 72°.

No other opportunity for sounding occurred until the 13th June, on a passage from Havana to Pensacola; on the evening of that day, being in latitude 27° 00′ North, longitude 55° 43′ West, we got bottom with 1327 fathoms, waxed line. Time of running 27 minutes 31 seconds. Temperature air 85°, temperature water 84°. Drift, at the rate of a half a mile an hour.

June 14th, 1851.—At 9 A. M., in latitude 27° 55′ North, longitude 85° 44′ West, got bottom with 376 fathoms line; some mistake was made in noting the time of running. Drift nothing. Temperature air 85°, temperature water 84°. At 6 P. M., of the same day, in latitude 28° 27′ North, longitude 85° 54′ West, got bottom with 220 fathoms line. Time of running 2 minutes 8 seconds. Temperature air 85°, temperature water 84°. Drift nothing.

Our line is nearly all expended; we have about 2500 fathoms remaining, and there is none in store here for future operations."

Captain Platt to Commodore Morris.

U. S. Ship Albany, San Juan de Nicaragua, *January 18th*, 1852.

"Sir:—I avail myself of an opportunity of sending a letter-bag by the "Prometheus," to forward my report of our deep sea soundings since July, 1851.

On leaving Pensacola in November last, I required from the Naval Storekeeper 40,000 fathoms of line and 12 leads, which had been sent there for the purpose of continuing these experiments.

On the 2d December, being in latitude 24° 25′ North, longitude 83° 23′ West, bottom was found with 1531* fathoms line; time running, 23 minutes 29 seconds. Drift, at the rate of a mile an hour. Temp. air 71°, temp. water 80°. I was much pleased to find the line of excellent quality.

December 10th, 1851.—In latitude 27° 04′ North, longitude 79° 44′ West, a sounding was got with 380 fathoms line; time of running, 4 minutes 51 seconds. Temp. air 74°, temp. water 80°.

The same day having changed our latitude to 27° 16′ North, longitude 79° 49′ West, we repeated the experiment, and got bottom with 274 fathoms line; time of running, 3 minutes 24 seconds. Temp. air 78°, temp. water 79°. This result being unexpected, the operation was immediately repeated, and bottom was got with 284 fathoms line; the same running time and temperature.

Having made up my mind to get several casts across the Florida stream, so as to make sure of the greatest depth at this part of its course; I was very much disappointed in finding myself upon the western side of the channel, as the soundings proved conclusively.

The wind was too light to enable me to get back into the middle part of the stream, and I was reluctantly compelled to relinquish my design.

The error in our position can be easily accounted for, by the fact that we were from 6 P. M. of the 8th, beating about in this narrow pass and rapid stream, without observations, or being able to get hold of any landmark. Near sunset of the same day, I ordered another cast to be taken, which gave bottom at 440 fathoms; time of running, 5 minutes 47 seconds. Latitude 27° 55′ North, longitude 79° 45′ West. Temp. air 73°, temp. water 79°.

On the 11th December, 1851, in latitude 27° 51′ North, longitude 79° 09′ West, bottom was got with 670 fathoms line; time of running, 11 minutes 49 seconds. Temp. air 78°, temp. water 76°. Drift, one mile an hour. At sunset of the same day, I renewed the experiment, and found bottom with 631 fathoms. I regard this sounding as perfectly accurate, every circumstance being favorable; latitude 27° 34′ North, longitude 70° 54′ West. Time of running, 9 minutes 38 seconds. Temp. air 75°, temp. water 76°.

On the 12th December, 1851, got bottom with 690 fathoms line; time of running, 10 minutes 22 seconds. Latitude 27° 19′ North, longitude 77° 18′ West. Temp. air 78°, temp. water 76°. Nearly calm, no drift.

At sunset the same day, having changed our latitude to 27° 10′ North, longitude 76° 59′ West, got another cast, and found bottom with 1180 fathoms line; time of running, 24 minutes 29 seconds. Temp. air

*There is probably a mistake as to the position of the ship when this sounding was made.—M. F. M.

75°, temp. water 76°. Nearly calm, no drift. I was much surprised at the great difference between this sounding and the preceding one, but there is no reason to doubt their entire accuracy.

December 13th, 1851.—Got bottom with 1916 fathoms, latitude 27° 10′ North, longitude 75° 06′ West; time of running, 43 minutes 13 seconds. Temp. air 81°, temp. water 76°. Drift one mile an hour.

December 14th, 1851.—It being quite calm at 9 A. M., sounded, but unfortunately the line parted after running 1590 fathoms. I regretted this accident, (the first that has happened to our new line, which is of superior quality) very much, as the line was quite perpendicular. A breeze springing up, I concluded to defer another trial until evening. At 5 P. M., we sounded again, and got bottom with 1,874 fathoms line; time of running, 52 minutes 4 seconds. Latitude 26° 28′ North, longitude 73° 50 West. Temp. air 78°, temp. water 76°. Drift, three fourths of a mile an hour.

On the 15th December, 1851, the deepest sounding was taken that has yet heen made by this ship; got bottom with 4396 fathoms line; time of running, 1 hour 52 minutes 57 seconds. Latitude 25° 30′ North, longitude 72° 07′ West. Temp. air 78°, temp. water 76°. Drift, one mile an hour.

On the 16th December, 1851, bottom was got with 2100 fathoms line; time of running, 48 minutes 7 seconds. Latitude 24° 48′ North, longitude 70° 22′ West. Temp. air 80°, temp. water 79°. Drift, three-fourths of a mile an hour.

On the 17th December, 1851, we commenced sounding in a calm, and ran out 3,600 fathoms line, without getting bottom. A breeze springing up ahead caused the line to foul under the bottom. Latitude 24° 41′ North, longitude 69° 39′ West. Temp. air 84°, temp. water 80°. Time of running, 2 hours 6 minutes 36 seconds. This experiment was made with one of the leads that were sent out with the line. It proves, I think, that they are too light, or that their shape is not the best for rapid descent. On the 15th inst., a 32 pound shot, was used, which went 800 fathoms deeper in 14 minutes less time.

December 19th, 1851.—Got bottom with 2,990 fathoms line; time of running, 1 hour 19 minutes 50 seconds. Latitude 22° 40′ North, longitude 69° 00′ West. Temp. air 80°, temp. water 80°. Drift, three-fourths of a mile an hour.

On the 9th January, 1852, our next experiment was made. In the interval, the ship visited Cape Haytien and Chagres. The passage between those two ports was particularly unfavorable for sounding, the wind being very fresh, and the sea high. Upon the date last mentioned, being on my passage from Chagres to his place, in latitude 9° 44′ North, longitude 81° 01′ West, got bottom with 1,690 fathoms line; time of running, 32 minutes 29 seconds. Temp. air 87°, temp. water 81°. Drift, three fourths of a mile an hour.

In order to enable you to compare the results furnished by the leads and shot, I annex the following tables:

December	2d,	32 pound shot.	December	11th, (2d)	32 pound shot.
"	10th,	(1st) lead.	"	12th, (1st)	32 pound shot.
"	"	(2d) 32 pound shot.	"	" (2d)	32 "
"	"	(3d) 32 "	"	13th,	32 pound shot.
"	"	(4th) 32 "	"	14th, (1st)	lead.
"	11th,	(1st) lead.	"	" (2d)	lead.

December	15th, 32 pound shot.	December	19th, 32 pound shot.
"	16th, 32 "	January	9th, lead.
"	17th, lead.		

It is proper to mention that the cruising of this ship, in the interval between the dates mentioned in the first paragraph of this report, was performed in the vicinity of Havana, near which place I had already taken so many soundings, that I was disposed to economise the small quantity of the line I then had, so as to use it in other places not yet visited by me.

Pensacola.—April 13th, 1852.—I have the honor to submit to you the result of two deep sea soundings made on my passage from San Juan de Nicaragua to Havana.

15th February, 1852.—Sounded and got bottom with 2,397 fathoms line; time of running, 47 minutes 29 seconds. Latitude 11° 23′ North, longitude 79° 36′ West. Temp. air 82°, temp. water 82°. Drift rather more than a mile an hour.

16th February, 1852.—Sounded and got bottom with 2,440 fathoms line; time of running 51 minutes 40 seconds. Latitude 12° 25′ North, longitude 78° 22′ West. Temp. air 82°, temp. water 80°. Drift one mile an hour.

These are the only soundings made since my last report."

Captain Platt mentions that these soundings were performed generally under the immediate superintendence of his accomplished first Lieut., Wm. Rogers Taylor, U. S. N.

Lieut Taylor kept minute records of the operations connected with each sounding, and had the kindness to furnish me with copies of them, simply for my own satisfaction. It is obvious that he never designed his sounding journals for publication. But they are not the less valuable for that reason; and he will I hope pardon me the liberty I am taking, for the sake of the motive I have in view, which is to let other officers have the benefit of his experience. The freedom with which the difficulties in his own case are stated;—his account of the manner of overcoming them, the statement of his success and his failures, will all afford most valuable assistance to other officers engaged with the same thing, and encountering similar difficulties. It is, therefore, that I take the liberty of publishing unofficial papers that were never intended for the public eye.

Deep-sea Sounding Journal kept by Lieut. Wm. Rogers Taylor, on board the U. S. ship Albany, Com. Platt.

Date.	Lat. Obs. N.	Lat. D. R. N.	Long. Obs. W.	Long. D. R. W.	Fathoms.	Time running out.	Temp're. Air.	Temp're. Water.	Remarks.
1850.	° ′	° ′	° ′	° ′			°	°	
Dec. 6.	—	38 38	—	66 31	1625	27 minutes	61	68	No bottom.
7.	37 09	—	64 59	Too rough to sound					
8.	35 14	—	63 01						
9.	—	33 34	—	61 38	1950	1 hour 3 m.	68	72	Drift 1 mile.

"MEM.—9th.—We lost six shot in attempting to sound to-day, owing to the heavy swell, which caused the line to snap when the ship rose abaft. We then tried a bar of iron which weighed about twelve pounds, which descended more rapidly than the shot; but the line failed and snapped. At length we resorted to a thirteen pound lead, and got bottom as above. The light weight of the lead caused the line to go out very slowly towards the last, but I have no doubt of the sounding. I set the drift at about one mile, from which you can easily calculate the perpendicular depth. The first day we lost one shot only by the parting of the line; the second attempt was entirely successful.

"10th. Lat. obs. N. 31° 54′. Long. D. R. W. 61° 15′. Too rough for sounding.

"11th. The experiments of to-day have cast a doubt over the former soundings, and I am now uncertain whether we have ever obtained bottom. This forenoon we got, as I supposed, an excellent cast, and the line stopped running out at 1,000 fathoms; the strain was very great upon the line, when it was pulled upon, but as the breeze was light, it was some minutes before it parted. I felt confident that we got bottom at the time. But this afternoon there was as perfect a calm as I ever saw; we thought it would be well to verify the cast of the forenoon, and renewed the soundings; the line stopped running out at 1,500 fathoms, and the ship had not drifted apparently ten yards; the line was up and down. But upon pulling upon it, the line came in gradually, though very heavily; indeed, sufficiently so as to cause me to believe that if the ship had had headway it would have parted. And yet we hauled in some three hundred fathoms, the weight diminishing as it rose, but with no sudden relief of strain, as if the line had snapped. It at once occurred to me that if the shot had broken the line at that depth, the effect upon the reel would have been the same, and it became doubtful whether we had got bottom in this, or in any other sounding. We have lost eleven shot to-day; once the line snapped at 300 fathoms, and once at 600 fathoms. I ought to say, rather, that the knots made by the rope-makers slipped. The twine seems to be of unequal strength, and sometimes parts without the slightest apparent cause; it may be that the knots have slipped on such occasions. I know that some knots have slipped, from hauling in the end, and finding it cut square off, whereas a fracture always leaves the strands of different lengths at the broken end. We have, at last, learned how to start the shot fairly, which is a point of great importance. Take three parts of the twine, for about fifteen fathoms, and lower the shot into the water carefully: hold back the reel (which is fitted with a crank, and stands upon a support,) until it takes the whole weight of the shot upon the three parts, eight or ten fathoms of which remain upon the reel; when all ready, let go the crank, and the shot descends without jerking; it is necessary to have a compressor upon the edge of the reel, to keep it from revolving too rapidly, as the line is apt to run off and get foul in such cases; a piece of old canvas in a man's hand, is probably the best thing of the sort that can be used. I am well satisfied with our reel, (which was made by Captain Platt's direction at the Boston Navy Yard,) and am also satisfied of the entire practicability of this mode of sounding, if you can get us good line; by good, I mean of equal strength. I send you a specimen of our twine, which easily bears the shot, but in some cases has parted with it when there has been no jerk, and no unusual duration of the strain. I should think that you might have good twine made of this size, of fine flax, and carefully knotted, or spun in one length, which would answer every requirement.

"Lat. obs. 30° 05′ N., long. chro. 58° 52′ W. Line run out 1,000 faths. Time running out 11 minutes. Temp. air 78°. Temp. water 74°. Lat. obs. 29° 58′ N., Long. 58° 48′ W. Line run out 1,500 fathoms. Time running out 28 minutes. Temp. air 72°, temp. water 74°.

"*December* 12*th.* The experiments in sounding to-day have been signally unfortunate, and I much fear that no satisfactory result will ever be obtained with the line we have. In fact, it is only throwing away the shot, and is moreover a complete loss of time. We lay to two hours to-day, and achieved nothing.

"The 1st shot parted after running 7 minutes, at a depth of 600 fathoms; the fracture took place near the surface, and I send you the end that we hauled up. You will see how it untwisted, although it did not break there. The twisted end, with a single knot upon it, is where it broke, I think there was a knot there which slipped.

"The 2d shot parted at about 20 fathoms below the surface; no jerk, and the reel running freely. I send you the end that we hauled up, it has two knots near it. You will see that both this and the former are clean, sharp, cut ends. I think that this also was knotted and slipped.

"The 3d shot parted the line between the reel and my hand, when it had descended 300 fathoms, and had been running about 2½ minutes. I send you the end which has three knots near it. It is a decided break; though there was no reason why it should have broken: the reel was running freely, and no strain upon the line. It is though evidently a weak spot.

"The 4th shot parted the line at a great depth, when it had run out 550 fathoms, and had been running 5 minutes.

"The 5th shot parted in the same way, after 200 fathoms had run out.

"In these five experiments the line was *oiled.*

"The 6th shot parted the line after 200 fathoms had run out; the oiling was dispensed with in this case.

"The seventh and last sounding was made with an unoiled line, with three bars of iron lashed together, about 18 inches long, and weighing about 12 lbs. The line parted after running out 1,000 fathoms between the reel and my hand, when the weight was descending very slowly indeed; there was scarcely strain enough to turn the reel; it is evidently a *slip*, as you may see from the end, which I send you; it has seven knots near it. It had been running 22 minutes.

"I also send you two specimens, cut from our twine, to show you what sort of stuff has been sent to us. As a matter of strict fact, we are somewhat to blame for the slipping of the knots, although we had no reason to suspect that they would slip before yesterday. Still, the makers should be rowed-up for being so faithless. By the way, we did not get the line until a day or two before we sailed, and had no chance to examine it carefully, and were even obliged to mark it in the greatest hurry. Capt. Platt was informed that it would be sent to him marked at every thousand fathoms, but it did not have a mark upon it. Send us good line, and we will give you as many soundings as you wish. The captain is much interested in the experiments, as you may see from the expenditure of shots; we have lost 25 in these few experiments, enough to show that the line is not trustworthy. A light weight gives very uncertain sounding, by reason of the great length of time it takes to run out, and the great drift in consequence.

"*December* 16*th*.—For several days past we have been overhauling the line, re-knotting it, and *waxing* it; to-day we made another experiment; the line run well, and parted at 1,600 fathoms. I have no doubt that the wax was of service to it, but the line is not suitable, and we did not deem it expedient to try it again to-day.

"Lat. obs. 21° 34′ N.; Long. chro. 63° 24′ W. Temp. air 84°, temp. water 81°. Time the line was running out, 28 minutes."

"*December* 29*th*, 1850.—Since our last soundings, we have visited St. Thomas, Santa Cruz, and Ponce. We arrived at St. Thomas on the next day, after taking the last sounding; the run from St. Thomas to Santa Cruz occupied about four hours only, and the passage from Santa Cruz to Ponce was made in the night. We are now on our way from Ponce to St. Domingo. This afternoon we hove to opposite that portion of the Mona Passage between the west end of Porto Rico and Mona Island. We were successful in getting bottom, beyond a doubt, and the fact settles the question of our former experiments, and *proves that we have never before got bottom*. I judge entirely from the strain upon the line, after the shot stopped; the drift of the ship was sufficient to part it, and the strain was unlike any we have had before. Lat. 17° 54′ N., Long. chro. 67° 28′ W. 1,200 fathoms of waxed line run out; drift about half a mile; time of running out, 17 minutes. Temp. air 81°; temp. water 84°. *One* shot expended.

"*January* 4*th*, 1851.—This morning we left San Domingo, and at noon being becalmed about nine miles from the land, we took advantage of the opportunity to get soundings. We got bottom with 370 fathoms up and down; time of running, 5 minutes. Lat. 18° 20′ N., Long. 69° 49′ W. Temp. air 80°; temp. water 82°. Line waxed. *One* shot expended.

"*January* 5*th*, 1851.—At 4 P. M. got another sounding. The line was waxed; it ran 19 minutes, and stopped at 1,275 fathoms; got bottom, without doubt. Altavela in sight, Lat. 17° 16′ N., Long. 71° 26½′ W. Temp. air 82°; temp. water 82°. *One* shot; drift, about half a mile.

"*January* 13*th*, 1851.—Yesterday we sailed from Aux Cayes. Hove to at noon this day, and made three unsuccessful attempts to get soundings.

"The 1st shot ran about two minutes, and the line parted at 250 fathoms.

"The 2d shot ran about three minutes, and the line parted at 300 fathoms.

"The 3d shot ran 18 minutes, and the line parted at 1,200 fathoms, *waxed line*.

"Lat. obs. 19° 12′ N., Long. chro. 76° 05′ W. Temp. air 83°; temp. water 82°.

"*January* 14*th*, 1851.—Very fresh wind, and the sea running too high for sounding.

"*January* 15*th*, 1851.—Same as yesterday.

"*January* 16*th*, 1851.—At 3.30 P. M. sent a boat to board a wreck lying upon the Colorados Reef; took advantage of the opportunity to sound, and got bottom with 420 fathoms line. Time of running 5 minutes; temp. air 82°; temp. water 80°; Lat. 22° 29′ N., Long. 84° 35′ W.

"Attempted to verify the above cast, and in so doing the line parted at 280 fathoms.

"On the next attempt a smart squall came up, causing us to drift very rapidly, and rendering the operation so uncertain that the result is not worth sending.

"At 5 P. M. being about 3 miles from the first position we got bottom with 720 fathoms, the line being eight minutes in running out. Lat. 22° 32′ N., Long. chro. 84° 32′ W. Waxed line.

"*January 28th*, 1851.—Sailed from Havana yesterday. Hove to at noon to-day, and got bottom with 470 fathoms; waxed line; time of running about six minutes; Lat 24° 05′ N., Long. 82° 05′ W.; temp. air 78°; temp. water 80°.

"*January 29th*, 1851.—Got bottom with 500 fathoms; waxed line; time of running about six minutes and a half; Lat 24° 37′ N., Long. 79° 48′ W.; temp. air. 79°; temp. water 79°.

"We lost two shots in unsuccessful attempts, the line having parted in both instances; once at 280 fathoms and once at 360 fathoms.

"*Mem.*—Deep soundings will, I think, always be attended with great uncertainty if there should be a current. For as the shot descends its velocity decreases, and when its rate of running becomes equal to the velocity of the current, it is obvious that you cannot tell whether it is on the bottom or not, as the line will continue to go out at the same speed, indefinitely. Would it not? This idea suggested itself to me to-day; being in the Florida stream, I expected to have got much deeper sounding, and was reflecting upon the uncertainty attaching to them when my shot brought up and settled the question, as regards this case, beyond all doubt.

"*January 30th and 31st.*—Blowing very fresh and a heavy sea running; sounding impracticable. We regret very much that we could not have got a cast in the Florida Stream, abreast of the Bahama Bank, near its northern extremity. It would have been interesting to have compared it with the soundings of the 29th.

"We are making a glorious run. During the 24 hours ending at noon to-day we ran 260 miles, and since noon (it is now 8 P. M.) we have averaged 12 knots. You will receive our abstract in due time. The Captain is deeply interested in your various investigations.

"*February 1st*, 1851.—Blowing a fresh gale from N. E. which prevented us from sounding. During the 24 hours ending at noon to-day, we ran 277 knots, and the observations put us still further on.

"*February 2d*, 1851.—Arrived at Cape Haytien in a fresh norther.

"*February 6th*, 1851.—Sailed from Cape Haytien at 7 A. M. this day. At noon got soundings in a calm; depth 640 fathoms; time of running 8 minutes 45 seconds. Position by bearing, Lat. 19° 57′ N. Long. 72° 11′ W., temp. air 82°; temp. water 82°.

"*February 7th*, 1851.—Got a cast in the windward passage, midway between Cuba and San Domingo; the result is very uncertain owing to the drift of the ship. We got out 840 fathoms line, but could not tell with any degree of accuracy the depth of the water, although the shot was, doubtless, upon the bottom. The best results are obtained in calm weather, for then the soundings are perpendicular. But when the breeze is at all fresh, it is impossible to keep the ship from drifting rapidly, and from falling off so as to gather headway before she comes to again. In this way, if the shot should happen to strike the bottom as she begins to shoot ahead, many fathoms (perhaps a couple of hundred) might be paid out before she stops. Perhaps I make too large an estimate. I suppose that something of the sort occurred to-day, for there was so much slack line to

haul in as to induce me to believe that it had parted, until we filled away, when it soon became apparent that the shot was fast. We shall seize the first convenient moment to try the experiment from a boat. It is almost throwing away the materials to sound from a sailing ship in anything like a fresh breeze, and yet we always reduce sail to topsails.

"*February* 18*th*, 1851.—Sailed from St. Jago de Cuba at 9 P. M. of the 16th inst. At 1 P. M. this day, in Lat. 15° 40′ N., Long. 77° 07′ W., got bottom with 1,300 fathoms, waxed line. Time of running about 17 minutes; temp. air 83°; temp. water 81°. Drift, about one quarter of a mile.

"This sounding is particularly satisfactory, as the ship was entirely still upon the water, at the moment the line stopped.

"*February* 19*th*, 1851.—At 5.30 P. M. got bottom with 600 fathoms, waxed line, in Lat. 11° 07′ N., Long. 79° 13′ W. Time of running 7 minutes; temp. air 82°; temp. water 82°. Drift at the rate of about a mile an hour.

"*March* 2*d*, 1851.—On the 20th ult., anchored at Chagres, from whence we sailed on the 22d. From that date to the 28th, we were beating to the northward and eastward, in comparatively shoal water, and the greater part of the time, the wind was blowing a gale. On the 28th we kept away to the northward and westward, with a smashing breeze and a large sea on, which rendered sounding impracticable. The evening of the 1st afforded the only opportunity, but unluckily we were about passing between two dangerous shoals, (Baxo Nuevo and Saranilla,) and it was important to keep our reckoning correct by running; as it was, we did not get through the difficulty until 9 P. M. This has been a favorable day for the operation, and accordingly at 1.30 P. M. we got a cast which resulted in giving us bottom with 895 fathoms. Time of running 12 minutes; Lat. 17° 54′ N., Long. 80° 25′ W.; temp. of air 84°; temp. of water 82°. Drift about 200 yards.

"At 5h. 15m. P. M. we got a second cast, which was taken in Lat. 18° 06′ N., Long. 80° 34′ W. We found bottom with 680 fathoms line; time of running 7m. 45s.; temp. air 83°; temp. water 81°.

"The line was waxed in both experiments. We never lose a shot now in starting the line, and our experience has taught us to overhaul the knots carefully, while waxing the twine, so that it parts less frequently than formerly. Here are two points gained, at least.

"*March* 3*d*, 1851.—The day has been passed in the vicinity of the Grand Cayman, where we have procured a supply of turtle, &c. for the crew. At 5.30 P. M., when about 20 miles West of that Island, we made three unsuccessful experiments in sounding. The 1st shot ran 6 minutes and parted with 660 fathoms out. The 2d shot ran 5 minutes and parted with 585 fathoms out. The 3d shot ran 3½ minutes and parted with 377 fathoms out. I can assign no cause for the repeated parting of the line, unless it be that it is of unequal strength, and we have fallen upon a weaker portion than we have had of late. The next experiment may throw some light upon the subject.

"*March* 4*th*, 1851.—At 5 P. M. got bottom with 990 fathoms line; time of running 14 minutes 45 seconds; Lat. 21° 25′ N., Long. 84° 45′ W.; temp. air 82°; temp. water 80°.

"*Mem.*—In overhauling the line to-day some parts were found which were very deficient in strength, being

easily broken by a light strain with the hand. It appeared as well as any other portion, and it is highly probable that the results of yesterday are attributable to a similar cause.

"*March* 5*th*, 1851.—We are now running towards the banks off Cape Catoche, (Yucatan,) and are not far from them. The captain thought a cast here would be important, and directed me to get one at 9 A. M. We found bottom with 445 fathoms line; time of running 4 minutes 40 seconds; temp. air 82°; temp. water 80°, Lat. 22° 05′ N., Long. 86° 22′ W.

"*March* 15*th*, 1851.—Having visited Sisal, Campeche, and Laguna, since my last date, running over the Campeche banks in from 8 to 10 fathoms, as we went from port to port. We sailed from the last named place this morning. At 5.30 P. M. being several miles outside of the deepest soundings laid down upon our charts, we got a cast which gave us bottom at 170 fathoms; the shot ran one minute and twenty-eight seconds; Lat. 19° 12′ N., Long 92° 56′ W.; temp. air 82°; temp. water 78°.

"*March* 18*th*, 1851.—At 9 A. M. got bottom with 530 fathoms line; time of running seven minutes and fifteen seconds; Lat. 19° 30′ N., Long. 94° 30′ W.; temp. air 81°; temp. water 76°.

"At 5 P. M. we got another cast, and found bottom with 967 fathoms line; time of running eleven minutes and thirty seconds: Lat. 19° 37′ N., Long. 94° 49′ W.; temp. air 80°; temp. water 78°. We also lost two additional shots by the parting of the line; one in the forenoon, and the other in the afternoon. In each case we lost about a hundred fathoms of line or more.

"These two soundings are as exact, in my opinion, as any that can be taken; the ship was perfectly still, and the line was nearly up and down.

"*April* 2*d*, 1851.—On the 17th March, we anchored at the Island of Sacrificios, near Vera Cruz, where we lay until the 28th, when we sailed for Tampico; the passage afforded no opportunity for sounding, as we ran down quite near to the coast. Yesterday, the 1st April, we sailed from Tampico for Havana; although very desirous to run a line of soundings across the Gulf, the weather to-day has been too rough for the operation, blowing fresh from E. N. E., and a heavy sea running.

"*April* 3*d*, 1851.—At 9 A. M. got bottom with 490 fathoms line, (waxed;) time of running six minutes and five seconds; Lat. 25° 56′ N., Long. 95° 51′ W.; temp. air 80°; temp. water 76°.

"At 5 P. M. made *three* unsuccessful attempts to sound, the line parting, each time, at 385, 400, and 405 fathoms; the time of running was 4 minutes, 3 minutes 40 seconds, and 5 minutes 45 seconds, respectively. Owing to this discrepancy, I am forced to conclude that some mistake was made in marking the line. These old quartermasters are very liable to err, as you well know, though Peter Alverdron (our signal quartermaster,) repels such a supposition with disdain, and says the *line didn't run* so fast the last time as it did the first!

"*April* 1*st*, 1851.—At 9 A. M. got bottom with 725 fathoms, *waxed* line; time of running eleven minutes; Lat. 26° 58′ N., Long. 92° 58′ W.; temp. air 78°; temp. water 74°.

"How can we account for the great difference in the quantity of line that runs out in equal intervals of time?

"For example, on the 16th ult. we got 967 fathoms in thirty seconds more time only than we had to-day

in getting 725 fathoms. I am sure of the time, and pretty sure of the correctness of the line. Can the density of the water vary, and produce this result?

"*April* 5*th*, 1851.—Got bottom with 982 fathoms line, (waxed;) time of running, 13 minutes 50 seconds; Lat. 26° 36′ N.; Long. 88° 56′ W.; temp. air 83°; temp. water 78°. Drift about one-fifth of a mile.

"*April* 6*th*, 1851.—Got bottom with 810 fathoms waxed line; time of running, 9 minutes 50 seconds; Lat. 26° 43′ N.; Long. 85° 27′ W.; temp. air 81°; temp. water 78°. Drift about one mile an hour.

"*April* 7*th*, 1851.—Got bottom with 700 fathoms waxed line; time of running, 7 minutes 30 seconds; Lat. 25° 23′ N.; Long. 85° 19′ W.; temp. air 81°; temp. water 78°. Drift about one mile an hour.

"We lost three shot, with about 200 fathoms line to each shot, by parting.

"*April* 8*th*, 1851.—Got bottom with 916 fathoms waxed line; time of running, 11 minutes 20 seconds; Lat. 24° 39′ N.; Long. 85° 12′ W.; temp. air 84°; temp. water 79°. *Calm.*

"*April* 10*th*, 1851.—Got bottom with 600 fathoms waxed line; time of running, 7 minutes 30 seconds; (up N. E. off N. by W., wind E. S. E., drift about a mile an hour.) I give you the above data, so that you may estimate what is due to the currents, in this position.

"Lat 23° 47′ N.; Long. 83° 32′ W.; temp. air 80°; temp. water 80°.

"*April* 19*th*, 1851.—Sailed from Havana this morning; at 6 P. M., got bottom with 995 fathoms waxed line; time of running, 16 minutes 48 seconds; Lat. 23° 21′ N., Long. 82° 44′ W.; temp, air 79°; temp. water 80°.

"Quite calm, and the line descended as nearly perpendicular as possible. The sea was perfectly smooth, on which account I permitted the shot to take the line off the reel, which accounts for the length of time in descending.

April 20*th*, 1851.—Being in the neighborhood of the Tortugas Islands, to the westward, but supposing ourselves outside of any soundings laid down upon the charts, the captain directed me to get a cast, more for the sake of verifying our position than for any other reason. To the surprise of all we found 21 fathoms only. Finding the line very strong, we actually raised the 32 pound shot from that depth, and recovered it! We do not require any better line than that. Do we?

"*April* 21*st*, 1851.—Got bottom with the patent lead in 52 fathoms; Lat. 25° 19′ N.; Long. 83° 41′ W.; temp. air 82°; temp. water 78°*.

"*April* 22*d*, 1851.— Got bottom in 137 fathoms; Lat. 26° 43′ N.; Long. 84° 41′ W.; temp. air 79°; temp. water 78°.

"*April* 23*d*, 1851.—Got bottom with 152 fathoms line; Lat 29° 12′ N.; Long. 86° 01′ W.; temp. air 76°; temp. water 72°.

"*June* 13*th*, 1851.—On the 13th May we sailed from Pensacola, to keep a look out for the "filibusters." We touched at Cedar Keys, Tampa Bay and Key West; our course kept us in shoal water until we arrived at

*The soundings of this and the day previous are in the vicinity of the deep soundings of 1,531 fathoms, Dec. 2d, page 181. Hence the doubt with regard to the position of the ship when that cast was made.

the last named place. On the 3d instant, we sailed for Havana, with orders to be there the next day, and so had no time to sound in running across. On the 6th, we sailed again in company with the Decatur, and that evening we were off Matanzas, where we lay until the 10th, when we started again, and hove to off Havana at sunset. On the 11th, we filled away for Pensacola, and to-day has furnished us the only opportunity for sounding that we had since we left Key West.

"This evening we got bottom with 1,327 fathoms line; time of running, 27 minutes 31 seconds; Lat. 27° 00′ N.; Long. 85° 43′ W.; temp. air 85°; temp. water 84°. Drift at the rate of half a mile an hour.

"*June 14th*, 1851.—At 9 A. M., got bottom with 376 fathoms; time of running, doubtful. I think that a mistake was made in noting it. Lat. 27° 55′ N.; Long. 85° 44′ W.; temp. air 85°; temp. water 84°. Drift nothing.

"At 6 P. M., got another cast to verify the forenoon soundings, and got bottom with 220 fathoms; time of running, 2 minutes 8 seconds; Lat. 28° 27′ N.; Long. 85° 54′ W.; temp. air 85°; temp. water 84° Drift nothing.

April 10th, 1851.—I improve the opportunity of a steamer to send you my fourth report of our sounding operations; you will perceive that we have got a line across the Gulf of Mexico, and that in no portion of the Gulf have we found quite 1,000 fathoms. As we enter the Gulf of Florida, the depth diminishes to 600 fathoms. You will recollect that we found only about 500 fathoms between Havana and the Great Bahama Bank. I am just preparing a small reel of sewing silk, which I intend to have waxed, and marked (by knots) to one thousand fathoms. I wish to try the experiment of sounding with it; having a small weight attached, to be determined by experience. We are now upon our last reel of twine, and I do not think we have more than 7,000 fathoms remaining; so unless you have a new supply for us at Pensacola, we must stop the work. You will never find another captain, I really believe, who will go into the thing so heartily as Captain Platt does."

From these results we are entitled to infer, that this method of sounding, if not corrected for the effect of under currents upon the line, will make the ocean appear rather deeper than it really is. A cast is made; the shot reaches the bottom; and the twine during the descent is swept off in a bight by an under current, the precise quantity of line taken out by it, cannot be determined, and by the length of the line so taken out, we are left in fault as to the true depth. I regard this method, therefore, as an approximation. But as a general rule, the approximation falls within comparatively narrow limits, and usually on the same side, viz: in excess; so as to make the ocean appear deeper, rarely shallower than it really is. These deep sea soundings, therefore, may be regarded as a step in the work of measuring the depth of the ocean, by assuring us that its depth is not beyond a certain extent.

But to return to Lieut. Taylor's interesting reports, in which the reader will find the points I have raised, fully discussed.

At Sea, Dec. 1st, 1851.—After nearly two months of inactivity at Pensacola, we are once more underway and started upon a cruise, which will, I hope, be productive of interesting results in the way of sounding. We found 40,000 fathoms of line and 12 leads at the Navy store which had been sent out for the pur-

pose of carrying on these experiments. We required the whole supply, and took it on board, supposing that we shall be able to consume it, before our term of service expires. The line has a beautiful appearance and we find no knots in it, the different lengths having been carefully joined at the rope-walk. It has also been waxed, and marked at every hundred fathoms. I regret, however, that so much trouble should have been thrown away in making it, for we are obliged to mark it over again, as there was no description of the marks sent with it, and in deep soundings we should always have been in doubt as to the *thousands*. I would suggest that in future the line should have some simple and conspicuous mark inserted at each hundred fathoms, without attempting to designate the *hundreds*, or the *thousands*, leaving that to be done on board the ships, in their own manner. But, if a careful description of the marks should accompany each reel, the plan of marking at the rope-walk would be a better one; and as it would save trouble on board ship, you would be likely to secure more soundings. I do not like the manner of marking adopted in this line. There is too great a similarity between the nine hundred and the thousand mark; each is a simple end of silk, in one case is taken round the line and in the other stuck through it. We find the measurement very exact.

I have been thinking of a plan to carry out the suggestion contained in your letter of the 25th April, of timing the descent of each hundred fathoms, and I think I have hit upon one likely to succeed. At the hundred fathoms mark, we attach a narrow strip of white cotton cloth, three or four inches long to the line, the ends being stuck between the strands. This can be easily seen as it passes out; and as soon as it becomes wet, it will lie close to the line, and add little or nothing to the friction. Upon these rags, we place our own marks, whose order of color, &c., are carefully noted in a book kept for the purpose.

2d December, 1851.—We are improving the time, by preparing our line for use whenever we may arrive at a spot not yet visited by us. The Captain is very desirous to give you some more casts in the Florida Pass, where we shall probably be very soon.

I send you the following memoranda, supposing that you may find them valuable in comparing the soundings by our new line, and those by the old, when using the 32 lb. shot; and in comparing the results of the new line, as afforded by the 32 lb. shot, and the new sounding lead. I refer of course to the time of descent, and the consequent influence of any under current upon the line.

1*st*—*The Reel.** It is obvious that when the diameter of the reel is increased by being full of line, it will revolve more freely than when the line is nearly run out, and the radius shortened. The account of every experiment, hereafter, will be preceded by a statement of the quantity of line on the reel. The latter is made like the ordinary log reel, except that the ends of the iron rod, serving as the axis, rests upon a wooden support or frame; they are always kept well oiled. It is two feet in length between the inner sides of the discs forming the ends; it is six inches in depth from the outer edges of these discs to the upper part of the wooden bars upon which the line is reeled; and this point, is three inches from the centre of the axis. When filled up square and even the reel contains 12,000 fathoms of the new line.

* Lieut Taylor afterwards found reason to change the opinion expressed above, he says: instead of turning more easily from the increased length of lever, *when full*, the great weight upon the axis produces so much friction, that it revolves more sluggishly, and we have to help it along by hand. The weight, therefore, will have to be considered when investigating the ratio of descent.

2d—*The line.*—The weight of one thousand fathoms of the line is 8¾ pounds. The weight of one thousand fathoms of the old line was 6 pounds.

3d—*The Leads.*—The leads are nine inches in circumference at the centre, and taper off to a point at each end; they are two feet in length and weigh upon an average 26½ lb.

Near sunset this evening, (Dec. 2d,) being just in the entrance of the channel between Cuba and the great Florida Reef, a short distance to the southward and westward of the Tortugas Bank, a sounding was taken, which resulted in getting bottom with 1531* fathoms. Time of running 23 minutes 29 seconds, Lat 24° 25′ N., Long. 83° 23′ W. Drift one mile an hour. Temp. air 71°; temp. water 80°.

The following is the result of our first attempt at noting the descent of each hundred fathoms. I am not very well satisfied with it, although I am now thoroughly convinced of the entire practicability of our plan. The reel contained at starting 9,100 fathoms of line, and the weight used was a 32 lb. shot.

Time of starting by watch, 4 hours 9 minutes 30 seconds.

	h. m. s.	The time of running out. m. s.		h. m. s.	The time of running out. m. s.
1st hundred	10 24	0 54	9th hundred	22 01	1 56
2d "	11 24	1 00	10th "	23 30	1 29
3d "	12 23	0 59	11th "	25 15	1 45
4th "	13 22	0 59	12th "	27 22	2 07
5th "	14 38	1 16	13th "	28 57	1 35
6th "	16 26	1 48	14th "	30 30	1 33
7th "	18 09	1 43	15th "	32 19	1 49
8th "	20 05	1 56	Got bottom	4 32 59	0 40

The above table presents discrepancies that I cannot well account for, but I send it to you just as it is, and you can take it for whatever you may think it is worth. Perhaps the time was not noted with accuracy, and I am somewhat inclined to think that such was the case. But a part of the difficulty is due, without any doubt, to the falling off and coming to of the ship: as she gets a little headway, the line runs off more rapidly than when she lies dead in the water, and the rate diminishes as she comes to. The time elapsed between the 11th and 12th hundreds was 2 minutes 7 seconds, she was then perfectly motionless. But between the 12th and 13th she had fallen off so as to fill the main topsail, which shot her ahead so as to take off that hundred in 1 minute 35 seconds.

Thus, you perceive, we meet with difficulties at every step:—the next question is, how are we to overcome them? We had a moderate breeze and a smooth sea. The sail was reduced to topsails and spanker; the main topsail was square aback, and the mizen sharp aback. We find that we do better in this way, than by keeping the mizen topsail full, since the stern-way that she gets now and then, tends to keep us nearly abreast of the shot. With the mizen topsail full, and the main braced sharp aback, she will still fall off so as to fill every thing,—and we lose the advantage of the stern-board.

* This is the sounding as to the position of which doubt has been raised; vide page 181.—M. F. M.

December 10th, 1851.—On the 6th inst., we sailed from Havana, and for three days we had to struggle against fresh gales from the northward and eastward, and a heavy head sea. Sounding has been impracticable until to-day. At 8 A. M., supposing ourselves to be on the eastern side of the Florida Stream, we got a cast, which gave us bottom with 380 fathoms line; Lat 27° 04′ N.; Long. 79° 44′ W. Time of running, 4 minutes 51 seconds. Temp. air 74°; temp. water 80°. No drift.

The reel contained 12,000 fathoms line at starting. We used one of your sounding leads* instead of a shot.

	h. m. s.	Time of running out. m. s.
Time of starting by watch,	7 53 35	
1st hundred	54 32	0 57
2d "	55 46	1 14
3d "	57 16	1 30
Got bottom	58 26	1 10

We then kept off to the westward, the captain having determined to run a line across the stream, which could have been done in a few hours under favorable circumstances. The wind soon became very light, however, and we have been doing little more than drift with the current all day. At 10 A. M., we got another cast, and got bottom with 274 fathoms line; time of running, 3 minutes 24 seconds; Lat. 27° 16′ N., Long. 79° 49′ W.; temp. air 78°; temp. water 79°. No drift. Used a 32 pound shot. Reel contained 11,600 fathoms.

	h. m. s.	Time of running out. m. s.
Time of starting by watch,	10 11 16	
1st hundred	12 18	1 02
2d "	13 34	1 16
Got bottom	14 40	1 06

This result was so unexpected, that it was immediately determined to verify it. Got bottom with 284 fathoms line; time of running, 3 minutes 24 seconds. Position the same, except as changed by the current. Used a 32 pound shot. Reel contained 11,300 fathoms.

	h. m. s.	Time of running out. m. s.
Time of starting by watch,	10 26 09	
1st hundred	27 11	1 02
2d "	28 27	1 16
Got bottom	29 33	1 06

There could not have been a more gratifying coincidence; but we were greatly disappointed at finding ourselves on the western side of the channel, as the wind was too light to enable us to get back into the middle of the stream. Somebody else may have better luck, and you must take the will for the deed, as regards ourselves.

At 5 P. M., sounded again, and got bottom with 440 fathoms line; time of running, 5 minutes 47

* See his description of it, page 193.—M. F. M.

seconds : Lat. 27° 55′ N.; Long. 79° 45′ W.; temp. air 73°; temp. water 79°. On the reel 11,000 fathoms; 32 pound shot.

	h.	m.	s.	Time of running out. m.	s.
Time of starting by watch,	4	54	20		
1st hundred		55	17	0	57
2d "		56	30	1	13
3d "		57	52	1	22
4th "		59	27	1	35
Got bottom	5	00	07	0	40

You will not fail to remark the difference between these intervals, and those of this forenoon. I cannot account for them. There never was a better chance for accuracy, as the ship was perfectly still, and the observers careful.

The positions that I have given you are only approximate ones; we did not get a good meridian observation but our latitude could not have been any greater, though it might have been somewhat less. I think that our longitude is too great, though I cannot guess how much; perhaps eight or ten minutes.

You will wonder, perhaps, how we came to be so far out of our reckoning this morning, but it can easily be explained. At 6 P. M., of the 8th, we got a departure from the light on the Double Headed Shot Keys, and from that time up to this morning, we were threshing about in this rapid current, tacking and veering every few hours, and without getting hold of any land mark, or securing any observations.

I have at length made the experiment of sounding with sewing silk, and find that it will not do; it untwists, and soon parts; if laid up into a small cord, (say three parts,) I have no doubt it would answer, but then it would be too expensive. I tried at first a small weight of two or three ounces; when nearly a hundred fathoms had run off, it sank so slowly, that I began to reel it up, and in doing so, the thread parted. I next tried a half pound weight; the first hundred fathoms ran off in 1 minute 46 seconds; the second hundred ran off in 2 minutes 22 seconds; the line then parted.

December 11*th*, 1851.— At 1 P. M., got bottom with 670 fathoms line; time of running, 11 minutes 49 seconds; Lat 27° 51′ N.; Long. 79° 09′ W.; temp. air 78°; temp. water 76°. Drift, one mile an hour. Reel contained 10,500 fathoms; *sounding lead used.*

	h.	m.	s.	Time of running out. m.	s.
Time of starting by watch,	12	51	33		
1st hundred		52	25	0	52
2d "		53	33	1	08
3d "		54	53	1	20
4th "		56	21	1	28
5th "		58	02	1	41
6th "	1	00	08	2	06
Stopped at		03	22	3	14?

The last interval, which I mark as doubtful, shows the advantage of timing the different hundreds. Here we have 3 minutes 14 seconds consumed in running out 70 fathoms of line. The fact is this, I presume : the lead touched the bottom while the ship had a little headway, sufficient to take the line off the reel slowly. As soon as she stopped, the reel stopped too. You see that I do not pretent to *cook* these experiments, but send you our work just as it is done, be it good or bad.

At 5 P. M., got another cast, as beautiful a one as could be taken. The line went down perpendicularly, and gave us bottom with 631 fathoms; time of running, 9 minutes 38 seconds; Lat. 27° 34′ N.; Long. 77° 54′ W.; temp. air 75°; temp. water 76°. Reel contained 9,800 fathoms: 32 *pound shot used.*

	h. m. s.	Time of running out. m. s.
Time of starting by watch,	5 5 12	
1st hundred	6 14	1 02
2d "	7 26	1 12
3d "	8 55	1 29
4th "	10 27	1 52
5th "	12 09	1 42
6th "	14 10	2 01
Got bottom	14 50	0 40

December 12th, 1851.—At 10 A. M., sounded and got bottom with 690 fathoms line; time of running, 10 minutes 22 seconds; Lat. 27° 19′ N.; Long. 77° 18′ W.; temp. air 78° temp. water 76°. Nearly calm—No drift.

	h. m. s.	Time of running out. m. s.
Time of starting by watch,	10 2 04	
1st hundred	2 57	0 53
2d "	4 08	1 11
3d "	5 29	1 21
4th "	7 04	1 35
5th "	8 43	1 39
6th "	10 23	1 40
Got bottom	12 26	2 03

Reel contained 9,100 fathoms: 32 pound shot.

At 5 P. M., sounded again, and got bottom with 1,180 fathoms line; time of running, 24 minutes 29 seconds; Lat. 27° 10′ N.; Long. 76° 59′ W.; temp. air 75° temp. water 76°. Nearly calm—No drift.

	h. m. s.	Time of running out. m. s.		h. m. s.	Time of running out. m. s.
Time of starting by watch,	5 3 53				
1st hundred	4 46	0 53	7th hundred	15 57	2 20
2d "	5 58	1 12	8th "	18 25	2 28
3d "	7 30	1 32	9th "	21 14	2 49
4th "	9 07	1 37	10th "	23 55	2 41
5th "	11 14	2 07	11th "	26 08	2 13
6th "	13 37	2 23	Got bottom	28 22	2 14

Reel contained 8,400 fathoms: 32 lb. shot. *Abaco* in sight, bearing S. E., just visible upon the horizon.

It would be difficult to obtain better soundings than those of to-day. The time has been noted by careful observers, and I have no reason to doubt its entire correctness; yet, you will remark discrepancies; as for example:—between the 5th and 6th hundreds of the forenoon soundings, and between the 6th and 7th hundreds, and the 9th and 10th, and 11th of this afternoon. And these are not so remarkable as will be found in the experiments of the 2d instant. Does your theory of submarine currents reconcile these apparent inconsistencies? There is not the slighest difficulty in marking the passage of the hundred marks, to a half second.

N. B.—I forgot to mention before, that as we always start from an even hundred, the odd fathoms are at the end of the operation. The time, therefore, between the last hundred and the close, gives the interval occupied by the descent of the odd fathoms.

If you will take the trouble to look back, you will perceive that the reel was in the same condition this forenoon, as it was on the 2d December. The shot was used in both cases, and yet how different the results. An interesting table might be made (if you should think it desirable) for comparison.

December 13th, 1851.—Sounded at 10*h.* 15*m.* A. M., and got bottom with 1,916 fathoms line; time of running, 43 minutes 13 seconds; Lat. 27° 10′ N.; Long. 75° 06′ W.; temp. air 81°; temp. water 76°. Drift, 1 mile a hour.

Time of starting by watch, 10 hours 00 minutes 47 seconds.

	h. m. s.	Time of running out. m. s.		h. m. s.	Time of running out. m. s.
1st hundred	1 46	0 59	11th hundred	19 44	2 21
2d "	3 00	1 14	12th "	22 54	3 10
3d "	4 27	1 27	13th "	25 11	2 17
4th "	6 02	1 35	14th "	28 45	3 34
5th "	7 37	1 35	15th "	31 29	2 44
6th "	9 12	1 35	16th "	33 53	2 24
7th "	11 00	1 48	17th "	37 26	3 33
8th "	13 05	2 05	18th "	40 29	3 03
9th "	15 33	2 28	19th "	43 21	2 52
10th "	17 23	1 50	Got bottom	44 00	0 39

Reel contained 7,200 fathoms line.—32 lb. shot.

The irregularities in the above table are very great, but I have no reason to doubt the correctness of the time, as it was noted by a very careful and experienced officer. To the four hundredth mark the line descended perpendicularly, but after that the ship was very unsteady, falling off and forging ahead rapidly at times. We have exerted all our ingenuity to keep her still, and the officers work the yards, while lying to, with the greatest care and watchfulness. I cannot speak too highly of the valuable co-operation that I receive from the officers generally. They are all willing to do everything in their power to carry out successfully these experiments. The Captain is a perfect enthusiast, and omits no opportunity of getting a cast, as this record plainly shows.

At 4 P. M., being in Lat. 27° 01′ N., Long. 74° 47′ W., I threw a bottle overboard, to try the current, with a request upon a slip of paper it contained, that the finder would forward it to you. I will continue to do so from time to time.

December 14*th*, 1851. At 9 A. M., it being quite calm, we sounded, but unfortunately, the line parted, after having run out 1591 fathoms. Time of running, 37 minutes 41 seconds; Lat. 26° 31′ N., Long. 74° 10′ W. Temp. air 81°; temp. water 76°.

Time of starting by watch, 9 hours 1 minute 12 seconds.

	h. m. s.	Time of running out. m. s.		h. m. s.	Time of running out m. s.
1st hundred	1 56	0 44	9th hundred	16 32	2 42
2d "	2 56	1 00	10th "	19 28	2 56
3d "	4 19	1 23	11th "	22 28	3 00
4th "	6 00	1 41	12th "	25 40	3 12
5th "	7 56	1 56	13th "	28 56	3 16
6th "	9 04	1 08?	14th "	32 12	3 16
7th "	11 22	2 18	15th "	35 40	3 28
8th "	13 50	2 28	Parted	38 53	3 13

Reel contained 5,300 fathoms. *Sounding lead* used.

This is the first accident that has happened to our new line, which proves to be of a very superior quality. Its strength is quite sufficient to bear the unequal strain, caused by the rising of the ship to the swell. It was a matter of great regret to all of us that this sounding was lost, as the line was perpendicular. A breeze springing up, we concluded to defer another trial until evening.

At 5 P. M. got bottom with 1,874 fathoms. Time of running, 52 minutes 04 seconds. Lat. 26° 28′ N., Long. 73° 50′ W. Temp. air 78°; temp. water 77°. Drift, about ¾ of a mile an hour.

Time of starting by watch, 4 hours 46 minutes 42 seconds.

	h. m. s.	Time of running out. m. s.		h. m. s.	Time of running out. m. s.
1st hundred	47 27	0 45	11th hundred	8 25	2 25
2d "	48 33	1 06	12th "	11 11	2 46
3d "	49 55	1 22	13th "	15 02	3 51
4th "	51 25	1 30	14th "	17 44	2 42
5th "	53 07	1 42	15th "	21 42	3 58
6th "	55 12	2 05	16th "	24 18	2 36?
7th "	57 53	2 41	17th "	30 58	6 40?
8th "	5 00 07	2 24	18th "	34 57	3 59
9th "	2 37	2 20	Got bottom	38 46	3 49
10th "	6 00	3 23			

Reel contained 3,700 fathoms. *Sounding lead* used.

These soundings show that the lead, although it gets through its 1st and 2d hundred fathoms more rapidly than the 32 lb. shot, is longer in accomplishing its descent when the depth is more than six or seven hundred fathoms. We have scarcely made experiments enough to establish the exact point where the ratio is changed. Taking the two casts of to-day for an example, we find that in the first the lead ran out 1,500 fathoms in 34 minutes 28 seconds, in the last in 35 minutes 0 seconds. The 32 lb. shot on the 13th inst., ran out 1,500 fathoms in 30 minutes 42 seconds, and on the 2d inst. in a much shorter time.

I cannot account for the great irregularity in the intervals between the 15th and 16th, and the 16th and 17th hundreds. The time was marked by an officer who is in the habit of marking the time several times a day, and I have every reason to believe in his accuracy.

Another advantage in timing the hundreds has just occurred to me. It will inform us when to stop paying the line out, after the weight has got to a great depth. For example, suppose the drift of the ship to be, as it generally is in a good breeze, about one mile an hour, that would be 100 fathoms in 6 minutes 8 seconds; therefore, whenever the interval between the hundreds amounts to that, it is evident that you may pay out line *ad infinitum*, and the weight be quietly resting on the bottom all the while.

At 1 P. M. threw another bottle overboard, in Lat. 26° 29′ N., Long. 74° 03′ W.

December 15th, 1851.—At 5 P. M. got bottom with ☞ 4,396 *fathoms* line. Time of running 1 hour 52 minutes 57 seconds. Lat. 25° 30′ N., Long. 72° 07′ W. Temp. air 78°, temp. water 76°. Drift, one mile an hour.

Time of starting by watch, 3 hours 32 minutes 12 seconds.

	h. m. s.	Time of running out. m. s.		h. m. s.	Time of running out. m. s.
1st hundred	33 07	0 55	23d hundred	20 30	3 02
2d "	34 13	1 05	24th "	23 29	2 59
3d "	35 22	1 09	25th "	25 55	2 26
4th "	36 35	1 13	26th "	28 51	2 56
5th "	38 20	1 45	27th "	32 06	3 15
6th "	40 12	1 52	28th "	34 45	2 39
7th "	42 01	1 49	29th "	38 21	3 36
8th "	43 51	1 50	30th "	40 56	2 35
9th "	45 58	2 07	31st "	43 56	3 00
10th "	48 10	2 12	32d "	47 05	3 09
11th "	50 06	1 56	33d "	49 57	2 52
12th "	52 26	2 20	34th "	53 10	3 13
13th "	54 43	2 17	35th "	55 57	2 47
14th "	56 57	2 14	36th "	59 11	3 14
15th "	59 38	2 41	37th "	5 1 53	2 42
16th "	4 1 45	2 17	38th "	5 09	3 16
17th "	4 15	2 20	39th "	8 05	2 56
18th "	7 06	2 51	40th "	11 27	3 22
19th "	9 22	2 16	41st "	14 15	2 48
20th "	11 02	2 40	42d "	17 06	2 51
21st "	14 57	3 55	43d "	21 16	4 10
22d "	17 28	2 31	Got bottom	25 09	3 53

Reel contained at starting 7,000 fathoms line. 32 lb shot.

N. B.—The reel was overhauled this forenoon and made to revolve more freely. This will account for the shorter intervals between the hundreds. I never saw it run so smoothly and freely as it did this afternoon.

This sounding is entirely satisfactory, not a doubt rests upon it in my mind. The great drift takes away a great deal from its value, it is true, but that could not be helped. We are saving up the *leads* for calm

soundings. In calculating the perpendicular depth, it has doubtless occurred to you that an allowance must be made for the curve of the line, between the ship and the weights, in the right-angle triangle, the hypothenuse is the chord of that arc, whatever it may be. Is it possible to calculate that curve? My mathematics do not extend so far as that; you know there was no Naval Academy in my day, although you, who came before me, were able to build a navigator without the aid of one.

Threw overboard another bottle to-day in Latitude 25° 42′ N.; Longitude 72° 20′ W.

December 16*th*, 1851.—At 4.30 P. M.; got bottom with 2,100 fathoms. Time of running, 48 minutes 7 seconds; Latitude 24° 48′ N., Longitude 70° 22′ W.; Temp. air 80°. Temp. water 79°. Drift about ¼ of a mile an hour.

Time of starting by watch, 4 hours 32 minutes 30 seconds.

	h. m. s.	Time running out. m. s.		h. m. s.	Time running out. m. s.
1st hundred	33 27	0 57	12th hundred	54 46	2 31
2d "	34 44	1 17	13th "	56 49	2 03
3d "	36 06	1 22	14th "	59 14	2 25
4th "	37 41	1 35	15th "	5 1 59	2 45
5th "	39 23	1 42	16th "	4 34	2 35
6th "	41 12	1 49	17th "	7 15	2 41
7th "	43 15	2 03	18th "	10 23	3 08
8th "	45 29	2 14	19th "	13 08	2 45
9th "	47 35	2 06	20th "	16 35	3 27
10th "	49 41	2 06	Got bottom	20 37	4 02
11th "	52 15	2 34			

Reel contained 6,000 fathoms. 32 lb. shot.

Threw another bottle overboard, in latitude 24° 55′ N.; longitude 70° 19′ W.

December 17*th*, 1851.—At noon, sounded, and ran out 3,600 fathoms line, *without getting bottom.* We commenced in a calm, but at the close of the operation, a light breeze sprang up on the side opposite to the one that the airs came from when we commenced, and which we had made the weather one. The consequence was a stern-board, and a foul line under the bottom: so to save the materials, we cut. Time of running, 2 hours 6 minutes 36 seconds! Lat. 24° 41′ N.; Long. 69° 39′ W.; temp. air 84°; temp. water 80°. Drift, (caused by light cats' paws,) perhaps a quarter, or a third of a mile, in all.

I am very much disappointed by this sounding; I had expected to get a perpendicular cast, and to find bottom, certainly;—If I had used a shot, I have no doubt I should have done so. This experiment shows that the leads are too light, or that their shape is not the best adapted for rapid descent. The shot on the 15th, went 800 fathoms deeper in nearly 14 minutes less time.

Time of starting by watch, 12 hours 31 minutes 54 seconds.

	h. m. s.	Time of running out. m. s.		h. m. s.	Time of running out. m. s.
1st hundred	32 42	0 48	19th hundred	22 16	3 24
2d "	——	——	20th "	25 48	3 32
3d "	35 31	2 49—200 faths.	21st "	29 30	3 42
4th "	37 23	1 52	22d "	33 02	3 32
5th "	39 34	2 11	23d "	36 42	3 40
6th "	41 55	2 21	24th "	40 35	3 53
7th "	44 23	2 28	25th "	44 06	3 31
8th "	47 04	2 41	26th "	47 54	3 48
9th "	50 02	2 58	27th "	52 07	4 13
10th "	52 56	2 54	28th "	56 18	4 11
11th "	56 00	3 04	29th "	2 0 37	4 19
12th "	59 06	3 06	30th "	4 51	4 14
13th "	1 2 13	3 09	31st "	8 55	4 04
14th "	5 33	3 20	32d "	13 49	4 54
15th "	8 57	3 22	33d "	18 30	4 41
16th "	12 17	3 20	34th "	23 30	5 00
17th "	15 32	3 15	35th "	30 38	7 08
18th "	18 52	3 20	36th "	38 30	7 52

Reel contained 6,000 fathoms at starting. Sounding lead used.

The reel was in fine running order on the 14th, on which occasion we went deeper with *the lead* than we have at any other time before to-day; we got out 1,800 fathoms in 48 minutes 15 seconds; our first 1,800 fathoms to-day, ran out in 46 minutes 58 seconds. If we had had much drift, I should have supposed that the lead struck bottom, and that the last three hundred fathoms was due to that drift; but as I have said, our cast was nearly perpendicular.

However, we have arrived at this fact, viz: that in the latitude and longitude mentioned, we have *at least* 3,600 fathoms of water.

At noon, threw overboard another bottle, with the usual request, that if picked up, the slip of paper should be sent to you, stating the date and place where found.

December 19*th*, 1851.—At 4, P. M., got bottom with 2,990 fathoms line; time of running, 1 hour 19 minutes 50 seconds; Lat. 22° 40′ N.; Long. 69° 00′ W.; temp. air 80°; temp. water 80°. Drift, three-fourths of a mile an hour.

Time of starting by watch, 4 hours 8 minutes 10 seconds.

	h. m. s.	Time of running out. m. s.		h. m. s.	Time of running out. m. s.
1st hundred	9 04	0 54	16th hundred	42 18	2 46
2d "	10 17	1 13	17th "	45 38	3 20
3d "	11 46	1 29	18th "	48 36	2 58
4th "	13 28	1 42	19th "	51 12	2 36
5th "	15 20	1 52	20th "	54 32	3 20
6th "	17 18	1 58	21st "	58 01	3 29
7th "	19 30	2 12	22d "	5 1 22	3 11
8th "	21 53	2 23	23d "	4 47	3 25
9th "	25 08	2 15	24th "	8 03	3 16
10th "	26 26	2 18	25th "	lost.	——
11th "	28 54	2 28	26th "	14 41	6 38 (200 fathoms.)
12th "	31 29	2 35	27th "	17 04	2 23 } 6 38=3 13
13th "	34 13	2 44	28th "	21 19	4 15 }
14th "	36 54	2 41	29th "	24 20	3 01
15th "	39 32	2 38	Got bottom	28 00	3 40

Reel contained 7,900 fathoms: 32 lb. shot.

We can now compare the results of *four* soundings with the 32 lb. shot, to the depth of 1,900 fathoms. On the 13th instant, the line ran 42 minutes 34 seconds.

			m. s.	
On the 15th instant, the line ran			37 10	Greatest difference 5*m*. 52*s*.
16th	"	"	40 38	
18th	"	"	43 02	

We did not sound yesterday, to economize the line, but we committed another bottle to the waves, and one to-day, making *seven* that are now adrift.

January 9th, 1852.—Since the last date, we have had no opportunity for sounding. On the 23d December we arrived at Cape Haytien, and sailed from there on the 29th for Chagres. The passage was particularly unfavorable for our purpose, the wind being fresh, and the sea high. This morning we weighed anchor, our destination being San Juan de Nicaragua. At 2 P. M., we sounded, and got bottom with 1,690 fathoms line; time of running, 32 minutes 29 seconds; Lat. 9° 44′ N; Long. 81° 01′ W.; temp. air 87°; temp. water 81°. Drift, three-fourths of a mile an hour.

Time of starting by watch, 1 hour 47 minutes 3 seconds.

	h. m. s.	Time of running out. m. s.		h. m. s.	Time of running out. m. s.
1st hundred	47 46	0 53	10th hundred	2 2 53	2 03
2d "	49 02	1 06	11th "	4 58	2 05
3d "	50 24	1 22	12th "	7 12	2 14
4th "	51 52	1 28	13th "	9 34	2 22
5th "	53 24	1 32	14th "	12 03	2 29
6th "	55 04	1 40	15th "	14 35	2 32
7th "	56 53	1 49	16th "	17 05	2 30
8th "	58 48	1 55	Got bottom	19 32	2 27
9th "	2 00 50	2 02			

4,900 fathoms on reel.—Sounding lead used.

San Juan de Nicaragua, *January* 18*th*, 1852.—This will be sent by the Prometheus this afternoon. In regard to sounding from the gangway, as you suggested, to obviate the snapping of the line, I conceive it would be almost impracticable, on account of the falling off of the ship, so as to bring the line astern; sometimes. It would be apt to get foul of the guns or rudder. The line you have sent us is perfectly competent to bear any strain arising from the motion of the ship. I think you must give up the idea of saving the line, except what can be hauled in after it parts; even that is not very good, as it becomes very much untwisted. If you contrive some plan to slip, I think there would be a difficulty in deciding whether you had got bottom; and you could never feel sure that your weight would remain attached until it reached the bottom.

"*February* 15*th*, 1852.—Sounded and got bottom with 2,397 fathoms line; time of running, 47 minutes 29 seconds; Lat 11° 23′ N.; Long. 79° 36′ W.; temp. air 82°; temp. water 82°. Drift rather more than a mile an hour.

Time of starting, 2 hours 27 minutes 31 seconds.

	h. m. s.	Time of running out. m. s.		h. m. s.	Time of running out. m. s.
1st hundred	—	—	13th hundred	49 04	1 52
2d "	29 28	—	14th "	51 25	2 21
3d "	30 32	1 04	15th "	53 29	2 04
4th "	31 53	1 21	16th "	55 31	2 02
5th "	33 39	1 46	17th "	58 11	2 40
6th "	35 30	1 51	18th "	3 0 20	2 09
7th "	37 03	1 33	19th "	2 43	2 23
8th "	39 02	1 59	20th "	5 35	2 52
9th "	41 13	2 11	21st "	3 7 34	1 59
10th "	42 52	1 39	22d "	10 07	2 33
11th "	44 55	2 03	23d "	13 02	2 55
12th "	47 12	2 17	Got bottom at	3 15 00	1 58

Line on reel at starting 3,200 fathoms: 32 pound shot used.

"*February* 16*th*, 1852.—Sounded and got bottom with 2,440 fathoms line; time of running, 51 minutes 41 seconds; Lat. 12° 25′ N.; Long. 78° 22′ W.; temp. air 82°; temp. water 80°. Drift one mile an hour.

Time of starting by watch, 4 hours 53 minutes 39 seconds.

	h. m. s.	Time of running out. m. s.		h. m. s.	Time of running out. m. s.
1st hundred	54 39	1 00	14th hundred	17 50	2 43
2d "	55 52	1 13	15th "	19 49	1 59
3d "	57 14	1 22	16th "	21 59	2 10
4th "	58 32	1 18	17th "	24 50	2 51
5th "	59 58	1 26	18th "	27 02	2 12
6th "	5 1 34	1 36	19th "	29 59	2 57
7th "	3 20	1 46	20th "	31 05	1 06 ?
8th "	5 22	2 02	21st "	34 50	3 45 ?
9th "	7 31	2 09	22d "	37 13	2 23
10th "	9 12	1 41	23d "	41 42	4 29 ?
11th "	10 52	1 40	24th "	44 23	2 41
12th "	12 42	1 50	Got bottom at	5 45 20	0 57
13th "	15 07	2 25			

Line on Reel at starting, 5,000 fathoms: 32 pound shot used.

NOTE:—The soundings of February 15th and 16th, were taken by Lieut. James H. Armstrong, on the passage from San Juan de Nicaragua to Havana.

Report of Deep-sea Soundings as far as the same have been received at this office, Dec. 24, 1852.

ALBANY.

Date.		Latitude. N.	Longitude. W.	Temp're water.	Time.	Fathoms.		Drift.	Up & Down.	Rate in Secs.
1850.		° ′	° ′	°	*m. s.*			*faths.*	*fathoms.*	*fathoms.*
December	6	38 38	66 31	68	27	1625	No bottom.	00		60.2
"	9	33 34	61 38	72	63 ?	*a* 1950		800		30.9
"	11	30 05	58 52	74	11	1000		00		90.9
"	11	29 58	58 48	74	28	1500		00		53.5
"	12				7	600		00		85.7
"	12				5	550		00		110
"	12				22	*c* 1000		00		45.4
"	12				2 30	300		00		120
"	16	21 34	63 24	81	28	1600 *w.*		00	1600*	57.1
"	29	17 54	67 28	84	17	1200 *w.*		440	1113	70.6
1851.										
January	4	18 20	69 49	82	5	370 *w.*		00	370*	74
"	5	17 16	71 26	82	19	1275 *w.*		440	1203	67.1
"	13	19 12	76 05	82	18	1200 *w.*		00	1200	66.6
"	16	22 29	84 35	80	5	420		00	420*	84
"	16	22 32	84 32	80	8	720		00	720	90
"	28	24 05	82 05	80	6	470 *w.*		00	470*	78.3
"	29	24 37	79 48	79	6 30	500 *w.*		00	500*	76.9
February	6	19 57	72 11	82	8 45	640		00	640*	73.1
"	18	15 40	77 07	81	17	1300 *w.*		220	1280	76.4
"	19	11 07	79 13	82	7	600 *w.*		50	598	85.7
"	28	17 54	80 25	82	12	895 *w.*		100	885	74.5
"	28	16 06	80 34	81	7 45	680 *w.*		00	680	87.7
March	3	19 20	81 50		6	660		00		110
"	3	"	"		5	585		00		117
"	3	"	"		3 30	377		00		107.7
"	4	21 25	84 45	80	14 45	990		00	990*	67.1
"	5	22 05	86 22	80	4 40	445		00	445	96.7
"	16	19 30	94 30	76	7 15	530		00	530*	73.1
"	16	19 37	94 49	78	11 30	967		00	967	84
April	3	25 56	95 51	76	6 5	490 *w.*		00	490	80.5
"	4	26 58	92 58	74	11	725 *w.*		00	725*	65.9
"	5	26 36	88 56	78	13 50	982 *w.*		180	962	71.1
"	6	26 43	85 27	78	9 50	810 *w.*		150	795	82.6
"	7	25 23	85 19	78	8 17	700 *w.*		100	693	84.3
"	8	24 39	85 12	79	11	916 *w.*		00	916	83.2
"	10	23 47	83 32	80	7 30	600 *w.*		90	593*	80

* Is the supposition admissable that in these cases, the shot reached bottom, and that the effect of current upon the line, and of the drift upon the ship, was such as to make the sea appear somewhat deeper than it really is? The whole table authorizes the conclusion, that the rate of 74 fathoms per minute, for 5′—January 4th—is too slow. Subsequent observations will probably throw more light upon this point.

a. A 10 lb. lead, instead of a 32 lb. shot, and line oiled.

c. Weight 18 lbs:—three iron bars.

w. Line waxed.

ALBANY.

Date.	Latitude, N.	Longitude, W.	Tem. water.	Time.	No. of shot	Fathoms.	Drift.	Up and Down.	Average rate per minute.
1851.	° ′ ″	° ′ ″	°	h. m. s.			*fath.*	*fath.*	*fathoms.*
April 19	23 21 00	82 44 00		16 48	1	*w* 995			52.9
" 21	25 19 00	83 41 00			1	52			
" 22	26 43 00	84 41 00			1	137			
" 23	29 12 00	86 1 00			1	152			
June 13	27 0 00	85 43 00		27 31	1	1327	206	1310	48.2
" 14	27 55 00	85 44 00			1	376			
" 14	28 27 00	85 54 00		2 08	1	220			
Dec. 2	24 25 00	83 23 00	80	23 29	1	1531	300	1502	65.1
" 10	27 4 00	79 44 00	80	4 51		380		380	79.2
" 11	27 16 00	79 49 00	79	3 24		274		274	80.6
" 11	27 16 00	79 49 00	79	3 24		284		284	83.5
" 11	27 55 00	79 45 00	79	5 47		440		440	75.8
" 11	27 51 00	79 9 00	76	11 49	*l.**	670	170	647	56.7
" 11	27 34 00	77 54 00	76	9 38	1	631		631	67.5
" 12	27 19 00	77 18 00	76	10 22	1	690		690	66.6
" 12	27 10 00	76 59 00	76	24 29	1	1180		1180	48.2
" 13	27 10 00	75 6 00	76	43 13	1	1916	620	1806	44.3
" 14	26 31 00	74 10 00	76	37 41	*l.*	1591		1591	42.2
" 14	26 28 00	73 50 00	76	52 4	*l.*	1874	575	1778	35.9
" 15	25 30 00	72 7 00	76	1 12 57	1	4396	1435	4100	38.8
" 16	24 48 00	70 22 00	79	48 7	1	2100	675	1893	43.7
" 17	24 41 00	69 39 00	80	1 26 36	*l.*	3600	250		28.4
" 19	22 40 00	69 0 00	80	79 50	1	2990	1170	2762	37.6
1852.									
Jan. 9	9 44 00	81 1 00	81	32 29		1690	350	1650	51.8
									x. z. m. s. m. s.
Feb. 15	11 23 00	79 36 00	82	47 29	1	2397	689	2290	1st 500 fath. 6 08 6 09 2d " " 9 13 9 14
" 16	12 25 00	78 22 00	80	51 41	1	2440	762	2320	3d " " 10 37 10 37 4th " " 12 6 11 16

JAMESTOWN.

Date.	Latitude, N.	Longitude, W.	Tem. water.	Time.	No. of shot	Fathoms.	Drift.	Up and Down.	Average rate per minute.
1851.									
June 3	36 43 00	74 10 00				1500	No b	ottom.	
" 4	36 33 00	73 0 00	77			2100		1900	
" 5	37 6 00	68 2 00	68			3000			
" 7	38 13 00	62 32 00				3700			
" 12	38 50 00	45 33 00	67			2000			
" 13	38 50 00	43 49 00	70			1600			
" 18	37 50 00	32 7 00				2000			
" 20						1800	No bott	om.	
" 21						2000			
" 23	36 0 00	27 20 00				4000	No b	ottom.	
" 24	35 6 30	26 52 40				2000			

* *l* A 26½ lb. lead used instead of a 32 lb. shot—see description of it, page 193.

DOLPHIN.

Date.	Latitude, N.	Longitude, W.	Tem. water.	Time.	No. of shot	Fathoms.	Drift.	Up and Down.	Average rate per minute.		
1851.	° ′ ″	° ′ ″	°	h. m. s.			fath.	fath.	fathoms.		
									1st 500 fm.	2d 500 fm.	3d 500 fm.
									m. s.	m. s.	m. s.
Nov. 24	25 59 52	37 44 30		41 15	2			1720	10 21	11 22	13 35
" 30	23 42 00	23 40 35		54 12	1			2180		40.2	Average rate of descent per min.
" 30	23 41 12	32 40 29		59 10	2			2210		36.3	
Dec. 1	23 10 44	32 26 44		1 1 04	2			2200		36	
" 7	20 2 44	25 26 28		1 7 55	1			1970*		29	
" 7	18 19 26	25 5 58		41 06	2			1675		40.7	
" 10	18 24 54	23 48 02		35 58	2			1612		44.7	
" 11	17 34 51	22 51 28		28 22	2			1370		48.2	
" 13	16 31 42	20 53 37		44 26	2			1941		45.6	
" 14	16 30 46	20 43 58		59 59	1			1875*		31.2	
" 15	16 59 37	21 32 39		35 21	2			1580		44.7	
" 16	15 23 57	22 6 07		14 07	2			1220		50.6	
" 16	15 9 17	22 22 07		25 44	1			1380		53.7	
" 17	15 7 40	22 49 23		30 06	1			1120*		37.2	
" 17	15 2 57	23 2 23		14 09	2			790		56	
PLYMOUTH.											
Sept. 2	37 28 00	51 32 00		1 55	1	5500	1760	5200		47.8	
" 9	34 11 00	43 21 00		1 5	1	2800				43	
" 13				54	1	2200	440	2150		40.8	
CYANE.											
Oct. 15	34 40 00	69 20 00		11 30		742				64.5	
" 16	32 13 00	69 22 00		8 00		600				75	
" 19	27 29 00	73 20 00		3 15		200				61.5	
" 20	28 27 00	73 27 00		9 00		960					
1852.											
Jan. 10	25 55 00	79 46 00				284					
" 16	24 15 00	65 38 00		15 00		345				23	
" 27	16 20 00	65 21 00		18 00		1000				55.5	
" 28	13 29 00	65 22 00		11 00		600				54.5	
" 29	11 38 00	65 51 00		5 48		315				54.3	
PORTSMOUTH.											
1851.											
Dec. 31	21 19 00	38 10 00		2 44 00	1	4700	None.	4700		28.6	

* Probably the sea is not so deep where these casts were made. See the slow rate of descent. There was but one shot used on these occasions. Could that have made the difference? M. F. M.

SUSQUEHANNA.

Date.	Latitude, N.	Longitude, W.	Tem. water.	Time.	No. of shot	Fathoms.	Drift.	Up and Down.	Average rate per minute.
1851.	° ′ ″	° ′ ″	°	m. s.			*fath.*	*fath.*	*fathoms.*
June 18	33 35 00	38 32 00	72	36 00	1	1800			50
DOLPHIN.									
1852.									
Jan. 7	11 7 15	21 56 54		0 19 07	2	1120			58.6
" 8	8 43 00	20 52 00		1 21 20	1	2290			28.1
" 9	7 17 00	20 7 00		0 45 13	2	1940			42.9
" 13	4 14 21	19 20 34		1 40 24	1	2670			26.6
" 14	3 42 18	19 6 00		1 42 30	1	2760			26.9
" 15	3 51 00	19 6 00		1 2 42	1	2760*w.*?			44.0
" 17	3 1 26	18 36 26		1 46 37	1	2725			25.6
" 18	2 36 00	19 22 00		1 28 53	1	2780*w.*			31.3
" *19	2 10 10	19 57 28		1 9 00	2	2690*w.*†			39.0
" 22	S.2 27 39	23 37 58		1 50 42	1	3020			27.3
" 24	5 42 00	25 40 30		1 32 37	1	2970*w.*			32.0
" 25	6 59 42	25 42 54		1 40 06	1	3250*w.*			32.5
" 27	4 11 34	24 0 41		1 48 56	1	3200*w.*			29.3
" 29	3 33 28	22 38 27		1 59 13	1	3575*w.*			30.0
" 31	2 26. 08	20 47 36		2 24 24	1	3450*w.*?			23.9
Feb. 5	N.0 45 01	18 28 40		1 0 03	1	2680*w.*?			44.3
" 13	S.0 31 52	17 45 23		1 33 51	1	2840*w.*			30.2
" 29	5 32 01	32 43 52		1 22 17	1	2490*w.*			30.3
TANEY.									
1849.									
Nov. 15	31 59 00	56 43 00	73	90		5700 *d.*	00	5700	63.3
SARATOGA.									
1850.									
Nov. 28	28 21 00S	29 31 00		90		3100 *e.*	00	3100	44.9

w. Waxed line. (?) Quere. † Waxed for 700 fathoms.

d. Wire used with 10lb. lead as weight.

e. Line of twine, three times size of Albany's, laid up; weight 32 lb. shot.

* Here, in Lat 2° 10′ N., Long. 19° 57′ W., H. M. S Pandora, got no bottom at 6,000 fathoms See Admiralty Variation Chart, for 1851.—Lee.

CONGRESS.

Date.		Latitude, S.	Longitude, W.	Tem. water.	Time.	No. of shot	Fathoms.	Drift.	Up and Down.	Average rate per minute.		
1851.		° ′	° ′	°	h. m.			fath.	fath.	fathoms.		
										1st 1000 f.	2d 1000 f.	3d 1000 f.
										m.	m.	m.
June	12	28 46	43 46			2	3000	880	2880*			
Aug.	7	23 59	43 44			1	120		90*			
April	1	35 20	51 30	69	36	1	1650		1000*			
"	3	35 23	47 27	68	1 6	1	2700	880	2550*	18	24	700 fms.
"	9	34 37	44 11	69		1†	2145	440	2093‡	12	15	in 24 m.
"	15	34 50	51 40	70	20	1	950		950*			
May	12	28 00	45 58	76	10	2	800					
"	12	28 00	45 58	76		2	2300					
"	13	27 32	47 08	76		2	320		320*			
Sept.	10	30 28	45 41	68		2			1780*			
ST. LOUIS.												
1852.		° ′	° ′ ″		h. m. s.					m. s.	m. s.	m. s.
Oct.	4	36 16 N.	46 52 15	78.5	2 9 35	1	5070		5070‡	15 30	32 30	54 54
DOLPHIN.												
1852.		° ′	° ′									
Oct.	4	39 39	70 30	67	33 30	1§	1000					
"	6	40 50	64 44	63	1 02	2	2200					
"	7	41 12	62 38	65	1 06	2	2200					
"	9	41 40	59 23	68	1 44	2	2600					
"	10	44 40	56 01	69	1 22	2	2595					
"	11	40 36	54 18	73	2 00	2	3450					
"	20	44 07	49 23	67	3 17	2	4580					
"	24	43 40	42 55	68	1 30	2	2700					
"	25	44 41	40 16	70	0 46	2	1800					
"	26						1500‖					

Lieut. Commanding S. P. Lee to Commodore Morris.

U. S. SURVEYING VESSEL "DOLPHIN,"

Port Praya, (Cape de Verd Islands,) Dec. 20, 1851.

SIR:—I submit the following report for the information of the Department.

The "Dolphin" sailed from Sandy Hook on the 8th of October, and arrived here on the 17th instant, having been 71 days at sea.

* Bottom.

† Paixhan shot, 70 pounds.

‡ No bottom.

‖ The above furnished by Mr. Kennon at my request.—O. H. Berryman.

§ Sounding lead.

Good search has been made for the following eight vigias, none of which could be found.

Name and date of reported discovery.		Latitude.	Longitude.
		° ′ ″	° ′ ″
"Potomac Sounding," -	- 1838	38 10 00 N.	67 26 00 W.
"Fields' Vigias," - -	- 1838	37 31 00	66 0 00
"Anfitrite Breakers," -	- 1846	35 50 00	66 4 11
"Dyet's Rocks," - -	- 1845	32 46 00	60 6 00
"Vigias," - - - -	- 1827	31 15 00	53 20 00
"Gandarias Rocks," -	- 1842	25 30 00	37 45 00
"Gombands Rock," -	- 1764	23 15 00	32 25 00
The "Emily's Bonetta Reef"	- 1845	16 59 00	21 30 00

Projections will be prepared showing the tracks of this vessel, the casts of the lead, and the radius of vision, during the search for each vigia.

The following deep sea soundings were obtained after we got beyond the northerly and westerly gales, which prevailed from the date of our sailing to the latter part of November.

No.	Date.	Sounding, in fathoms.	Latitude.	Longitude.	Remarks.
	1851.		° ′ ″	° ′ ″	
1	Nov.24	1720	25 59 52	37 44 30	Bottom was certainly got at each of these casts. Sounded from a whale boat always; generally used two 32 lb. shots on small fishing line stuff, treble to the 1st 100 fath., double to the 2d 100, and single after that. Line ran over a roller hung to an inflated bag, and by using 2 oars, as the wind and sea made necessary, prevented drift, kept the line running "up and down" and the weight of the boat off the shot, and when the line began to run slow, kept the weight of the reel off the shot by turning it. A small and short, is worse than a high, long and regular sea, but a good sounding may be had with good line (which we have not,) from a boat in any weather in which it can be lowered safely.
2	" 30	2180	23 42 00	32 40 35	
3	" 30	2210	23 41 12	32 40 29	
4	Dec. 1	2200	23 10 44	32 26 44	
5	" 7	1970	20 2 44	25 26 28	
6	" 7	1675	18 19 26	25 5 58	
7	" 10	1612	18 24 54	23 48 02	
8	" 11	1370	17 34 51	22 51 28	
9	" 13	1941	16 31 42	20 53 37	
10	" 14	1875	16 30 46	20 43 58	
11	" 15	1580	16 59 37	21 32 39	
12	" 16	1220	16 23 57	22 6 07	
13	" 16	1380	15 9 17	22 22 07	
14	" 17	1120	15 7 40	22 49 23	
15	" 17	790	15 2 57	23 2 23	

The astronomical, magnetic and meteorological, and other observations required, have been made as far the weather permitted, and when the results are discussed, they will, I hope, be found interesting and useful.

The officers and crew are generally in good health. Commodore Lavallette is opportunely here, and affords every facility in his power.

As soon as the vessel is provisioned and watered, and the chronometers are rated, I shall put to sea and carry out the orders of the Department.

P. S.—I hope to return early in May, the beginning of a favorable season for following up the unexecuted part of my instructions which refer to the European routes. In that part of the Atlantic are located most of the reported rocks, shoals, and other dangers which are continued on the latest official charts. It is wonderful that no maritime nation has heretofore undertaken a systematic search for these reported dangers which render navigation uneasy, if not unsafe. The credit of conferring this essential service upon commerce will belong to the present administration of naval affairs. Care, however, must be taken to conduct the examination so thoroughly that when the detailed report is published, with diagrams, all the foreign hydrographical offices may be satisfied. Nothing could be more unfortunate than a superficial search, should the vigia subsequently prove to be the real danger. When the chart is once cleared of vigias, a rigid scrutiny should immediately be made into all subsequent reports of such dangers. I am preparing some suggestions to expose careless, incapable, or fraudulent navigators, or those advertising for notoriety—in one or the other of which causes many of these vigias have their origin. Most of the vigias of the Atlantic are retained on Maury's late Charts, and the new Admiralty Charts of June last, and they will continue to be regarded as real dangers, until they are proven to be otherwise.

I incline to regard many of the currents reported as the result of bad navigation. Careful astronomical observations for Lat. and Long., made at A. M. and P. M., twilight (12 hours apart,) compared with the run by patent log, indicate very little or no current by day, but show some defective steering, &c., by night. I use but one binacle, allow but four persons to steer, and do not rely upon a single observer and computer. I made some experiments in 30 fathoms water on our coast with two whale boats, one anchored by a kedge, the other having a suspended kettle, which lead me to suspect, that when there appears to be a current setting to windward, it is sometimes but the boat and pitch kettle, set to leeward by light airs and sea.

Deep-sea Soundings—U. S. Surveying Brig "Dolphin," Lieut. Commanding S. P. Lee.

Date.		Depth.		Latitude, N.	Longitude, W.	Remarks.
		Fathoms.	Miles.	° ′ ″	° ′ ″	
1852.						
Jan.	7	1120	1¼	11 7 15	21 56 54	Bottom was found at each cast.
"	8	2290	2½	8 43 00	20 52 00	
"	9	1940	2¼	7 17 00	20 7 00	The depth of the sea is given to the
"	13	2670	3	4 14 21	19 20 34	nearest quarter of a statute mile.
"	14	2670	3	3 42 18	19 6 00	
"	15	2670	3	3 51 00	19 6 00	
"	17	2725	3	3 1 26	18 36 26	
"	18	2780	3	2 36 00	19 22 00	Here H. B. M. ship "Pandora" got no
"	19	2690	3	2 10 10	19 57 23	bottom in 6,000 fathoms. See Ad-
"	24	2970	3½	5 42 00	25 40 30	miralty Variation Chart, for 1851.
"	25	3250	3¾	6 59 42	25 42 54	
"	27	3200	3¾	4 11 34	24 0 41	
"	29	3575	4	3 33 28	22 38 27	
"	31	3550	4	2 26 08	20 47 36	
Feb.	5	2680	3	0 45 01	18 28 40	
"	13	2840	3¼	0 31 42S	17 45 23	
"	29	2490	2½	5 31 48S	32 43 44	

Passed Midshipman A. F. Warley to Lieut. Maury.

U. S. SHIP "JAMESTOWN"—*Norfolk to Madeira.*

MADEIRA, *June* 28, 1851.

"DEAR SIR:—Knowing the interest you feel in deep sea soundings ordered by the Bureau of Ordnance and Hydrography, I send you a rough abstract of those taken up to the present time on borad of this vessel. I presume you will receive an official report from the proper source on the subject when the vessel shall have reached her station. The Master has sounded every day when the weather permitted, using sometimes one, sometimes two, round shot. The nippers for sounding proving of no use have been dispensed with, and the supposition of having on several occasions reached bottom, arose from the fact that the line paying out briskly would suddenly cease, and on being hauled in would for a moment come up very heavily, and then, as though the weight of the shot had parted from it, come up easily."

Date.		Latitude, N.	Longitude. W.	Air.	Water.	Depth Sounded.	Remarks.
1851.		° ′ ″	° ′ ″	°	°	*fath.*	
June	3	36 43 00	74 10 00			1500	No bottom—line parted—nipper defective.
"	4	36 33 00	73 0 00	72	77	2100	1,900 up and down—no bottom—lost 1,900.
"	5	37 6 00	68 2 00	71	68	3000	Supposed to have got bottom.
"	7	38 13 00	62 32 00			3700	Do. Do.
"	12	38 50 00	45 33 00	68	67	2000	Do. Do.
"	13	38 50 00	43 49 00	70	70	1600	Do. Do.
"	14					900	Line parted.
"	18	37 50 00	32 7 00			2000	Supposed to have got bottom.
"	20					1800	Ship forging ahead—line parted—no bottom.
"	21					2000	Supposed to have got bottom.
"	23	36 0 00	27 20 00			4000	No bottom.
"	24	35 6 30	26 52 40			2000	Line parted—no bottom.

Commander John Kelly to Commodore Warrington.

U. S. SHIP "PLYMOUTH," FUNCHAL ROADS, MADEIRA,

September 24, 1851.

"SIR:—In compliance with your circular of the 1st June, 1850, I have to report the result of my deep sea soundings during my passage to this place. The weather being very unfavorable, I did not sound until the 3d of September, in Lat. 37° 28′ N., and Long, 56° 32′ W., when I hove to and let the line run out one hour and fifty-five minutes, at which time it had taken 5,500 fathoms off the reel.

The ship's drift during this time, as near as we could ascertain by the log, I supposed to be about two miles. At this time the wind and sea had both increased so much, I deemed it advisable to part the line and await a more favorable opportunity, not being able to sound with any accuracy. On the 9th, the weather being more favorable, I again got a cast, Lat. 34° 11′ N., Long. 43° 21′ W., the line continued running off rather more than an hour; at this time there was 2,800 fathoms run off, when the line became slack, hauled

it in by hand until it was quite taut, finding it would not run out except by the drift of the ship, I presumed it must have reached the bottom, and ordered the line to be reeled up, when it parted at 100 fathoms from the reel. On the 13th inst., the weather smooth, I got another cast. Let go the shot at 9, and the line continued running out until 9.54, when it stopped, except as the ship drifted. At this time there were 2,200 fathoms out, and the line slack. Reeled up 45 fathoms when the line parted. The ship's drift during the time was nearly one half of a mile.

I intend in future, when the weather will permit, to sound from a boat, as by means of the oars I can keep the boat directly over the shot, and thereby be enabled to get an up and down cast."

Commander Jno. S. Paine to Commodore Morris.

U. S. Ship "Cyane,"

Off Laguayra, S. A., February 4, 1852.

"Sir:—I have the honor to forward you a report of the soundings taken by this vessel, with the apparatus furnished us at Norfolk.

From the weakness of the line, these soundings are not so certain as they would otherwise be; the same cause has prevented generally the attempt to take soundings."

Date.	Length of line lost.	Soundings.	Latitude.	Longitude.	Time of running out.
1851	*fathoms.*	*fathoms.*	° ′	° ′	
Oct. 15	349	742	33 40	69 20	11 minutes 30 seconds.
16	588	600	32 13	69 22	8 minutes.
19	153	200	27 29	73 20	3 minutes 15 seconds.
20	not shown.	960	28 27	73 27	No bottom—time not shown.
1852					
Jan. 10	277	284	25 55	79 46	" "
16	315	345	24 15	65 38	15 minutes.
17	75	No bottom.			
27	1000	1000	16 20	65 21	18 minutes.
28	155	600	13 29	65 22	11 "
29	308	315	11 38	65 51	5 minutes 48 seconds.
June 8	199	199	29 30	86 44	2 " 5 "
9	—	490	28 15	86 08	9 "
11	3000	none.	25 52	85 16	1 hour 4 minutes.
13	180	none.	23 18	83 54	5 minutes.
17	29	30	27 15	79 56	30 seconds.
18	—	75			Grey sand and shells.
20	288	230	32 30	77 18	3 minutes.
20	80	294 } No bottom. }	35 15	74 15	5 "
10	2080 } Line broke }	No bottom.	28 04	85 48	38 "

These soundings it will be observed, like those of several other vessels, are obviously too defective to challenge any considerable degree of our confidence. We have no drift in any of the soundings given by this vessel, and no remark showing why there is no drift. There is also a total absence of information as to the

weight used for sounding, and the most glaring inconsistencies in the soundings themselves seem to have passed by unnoticed. For instance: see the soundings of October 16th, 1851, and January 28th, 1852, of 60 fathoms each; yet in one case the time of descent is 8 minutes; in the other it is 11 minutes; so also the sounding of Jan. 16. Though the cast was but 345 fathoms, the time of running out is stated to be 15 minutes!

The time seems not to have been very accurately noted. The times are quoted thirteen times, eight of which happen to be exactly *even* minutes, and three are *even* five seconds. And there is little or no agreement among them. How different is the case with the Albany. The soundings in that ship were taken with the utmost care and they are discussed by Lieut. Taylor in a masterly manner. Officers are respectfully referred to his discussion of them, pp. 183 to 205, as a guide.

Acting Master T. Pattison to Commander Dornin.

U. S. S. "PORTSMOUTH."

"On the 31st December, 1851, in Lat. 21° 19′ N., and Long. 28° 10′ W., at 2 P. M., the weather being favorable (perfectly calm,) we commenced to get a deep sea sounding with the small line, 10,000 fathoms in length, using one 32 pdr. shot.

At the first attempt to lower the shot to the water, the line parted. We then took three parts of the line for ten or twelve fathoms, and succeeded in lowering the shot below the surface of the water, when the line was allowed to run from the reel. The line ran out without interruption, from 2 P. M. to 4 hours 44 minutes, P. M., making 2 hours and 44 minutes, taking out in that time 4,700 fathoms of line, during the last hour the line ran out very slowly. The line during all this time was up and down, showing no current. The ship during the period of sounding was perfectly still. Not a breath of air stirring, and very little swell. At 2 hours 44 minutes the line, running out very slowly, was stopped, and we commenced reeling up. After getting 25 or 30 fathoms, the line parted.

The temperature of the air being 78°; water 79°."

Commander W. S. Walker to Commodore Warrington.

U. S. SHIP "SARATOGA,"

Off Macao, April 9, 1851.

"SIR: In accordance with the instructions of the Burean of Ordnance and Hydrography, contained in the Circular, dated June 1st, 1850, relative to the taking of deep sea soundings—

I have to report, that on the 28th November, 1850, in Lat. 28° 21′ S., Long. 29° 31′ W., I obtained soundings (with the line prepared for that purpose by the direction of the Bureau) in 3,000 fathoms water; the time occupied by the line in running out, being 1 hour and 9 minutes.

This was the only opportunity of obtaining deep sea soundings, which occurred during our passage from the United States to China."

Acting Master J. Mathews to Captain Wm. Inman.

U. S. STEAM FRIGATE "SUSQUEHANNA,"

At sea, June 24, 1851.

"SIR: Below is the result of the deep sea soundings taken on board this ship on the 18th inst:

Date.	Lat. obs.	Lat. D. R.	Long. D. R.	Long. Chro.	Faths. out.	Time of running.	Temp.		Faths. Lost.
							Air.	Water.	
June 18	° ′ 33 35 N.	° ′ 33 37 N.	° ′ 38 23 W.	° ′ 38 32 W.	1800	36 min.	° 71	° 72	1510

NOTE.—For the purpose of arriving at greater accuracy a boat was lowered, and the line was under-run until it was up and down at 1,510 faths. when it was cut. I am of opinion that the shot was on the bottom."

Commander James D. Knight to Commodore Warrington.

U. S. S. "GERMANTOWN,"

Anchorage off Monrovia, July 2, 1851.

"SIR: I have the honor to report that, on the 17th and 26th of April last, and on the 7th of June, we made several attempts to sound the ocean; in all, eleven. The greatest quantity of twine veered out at any one time, did not exceed 200 fathoms. The loss attending these attempts was about 1,200 fathoms of twine, and eleven condemned 32 lb. shot. These failures are no doubt to be attributed somewhat to the inferior quality of the twine; to its having been in store at the New York Navy Yard, some four or five months before we got it, (it having been made for the "Dale," but not finished in time for her to get before she sailed,) and therefore perhaps not perfectly sound.

It is about two-thirds smaller in size, and no doubt three-fourths less in weight, and many times less in strength, than that of the "John Adams." Besides, the reel provided this vessel is a very common one, such as are used for reeling rigging upon in store; whereas that of the John Adams is fitted with patent friction rollers, &c.

I am sorry to say, that I am of opinion that we shall not be able to get soundings in any depth over 200 fathoms—still I shall not fail to sound again when in deep water, and the weather will admit of it."

To these accounts, I have appended Lieut. Walsh's deep-sea sounding in the "Taney" with wire; and the "Saratoga's" deep-sea sounding in the South Atlantic. The S. had 100,000 fathoms of sounding line on board of triple the size of that with which the "Albany" was furnished. She, much to my regret, went all the way from the United States to Rio, without getting a single cast; nor has any thing been heard from her in the way of deep-sea soundings, since she reported the one quoted in the table—though she has traversed the Indian Ocean and been cruising in the China seas. "The St. Mary's" was supplied with twine like that of the "Albany"; she went around Cape Horn, and reported from Rio on her way, that she could do nothing in the way of deep sea sounding with such twine.

The fine steam frigate Susquehanna also went to the coasts of China properly equipped for deep-sea soundings, but she has reported only one cast during the trip. I have also enlarged the table by the addition of the soundings of the "Cyane," "Plymouth," "Portsmouth and "Dolphin," additional ones from the "Albany," are likewise included. Some of the returns are meagre enough, but this table is greatly enriched by the soundings of the two vessels last named, for their work is particularly interesting and valuable.

And here I take leave to remind my brother officers, to whom the general order (page 174) is directed, and whose special duty it is to look after these soundings, that the depths of that part of the ocean south of the Cape Horn parallel of latitude, and of that part south of a line from the Cape of Good Hope to Van Dieman's Land, have a special interest attached to them.

There, in that great waste of water which encircles the South Pole, the tidal wave which reaches our shores is said to have its genesis.

*The chief region of water appears in reality to surround the South Pole, and if we recollect how peculiar the nature of the Pacific, how much it is intercepted with coral reefs, and islands, and insular continents, we shall readily perceive how far it is removed from the condition of an equatorial canal of uniform, unimpeded, great depth; presenting on the contrary, a coral barrier nearly impervious to tidal action.

"The source of the tides is therefore to be sought in the great reservoir of ocean round the Southern Pole. This polar reservoir is agitated on opposite sides by the Moon in its alternate lower and upper transits, and by the Sun in a less degree. Here the great central agitation seems to commence, and hence on all sides, it seems to flow northwards. From the South Pole this great agitation flows into the Indian Ocean, and proceeding northward, the great tide-wave strikes with violence on the shores of Hindostan; and finally, breaks in the mouth of the Ganges, where it expends its force on the shores in the form of the well-known and terrific bore of Hoogly. The Atlantic in like manner receives from the southern reservoir its great wave of tides, which passes northward with impetuosity, and expends its forces on the shores of Britain and North America, when again it becomes the enormous stream-tide of the British channel, and the destroying surge of the Bay of Fundy, so well known to all mariners. From the South in like manner the Pacific should receive its great tide, even if barricaded out by innumerable submarine steppes, and its thousand coral reefs, and its myriads of happy islands, to whose calm seas no propagation of this great horizontally-acting wave can gain access. It is by depth and uninterrupted bottom only that a great wave like the tide can force entrance—it is only the small waves raised by a local tempest that travel over the surface—an action like the tide, extending uniformly to all depths of the ocean, cannot be propagated on a superficial coating alone. The tides are built out of the Pacific by submarine works, and enter it alone, and with difficulty, by the eastern side of America, where diffused and rapidly diminishing, the tide extends a certain way, through the more open parts of the sea, continually diminishing in intensity. In the North Pacific, we have neither the bores of a Hoogly, nor the terrific tides of a Bay of Fundy. It is thus that we shall best understand the tides of these northern seas, in tracing them back to their genesis by the joint action of the Sun and Moon on the waters of the Southern Polar Ocean. Then we must conceive that the elevation and horizontal mo-

*Vide Johnston's Physical Atlas.

tions are first communicated to a vast mass of deep water, which imparting this impulse to all the surrounding mass, sets in motion the waters of all the southern mouths of our seas, and propagates to our shores long after their original force has been impaired, the effects of the derangement of the equilibrium of that central reservoir from which alone our tides are derived."

Taking the impulse received in the great South Sea cradle, the tidal wave commences its flow towards the North. Its march and its progress are thus sketched in the physical Atlas of Professor Alexander Keith Johnston:

"Commencing with the new or full Moon, let us take the spring tides, or largest tides formed by the coincidence of the actions of Sun and Moon. Let us conceive that this joint action has taken effect on the waters of the Antarctic Ocean—that the luminaries, in conjunction or opposition, have passed over the mass of waters lying east from Van Dieman's Land, New Zealand, and the South Pole, and have communicated to them motion in the direction of the resultant forces, we ahall manifestly have a mass elevated and moving to the North and West, following the luminaries. The motion thus communicated to this mass of water has raised a large mass, or moving ridge of water which cannot expend its forces acquired but by pushing before it other masses of water and raising them in a wave to which all its force is finally imparted. In this way, the wave originally generated, travels northward and westward, long after the bodies generating it have ceased to act on the first mass of water. The wave generated during the transit of the Sun and Moon on Monday morning, and producing high water on the coast of Van Dieman's Land at twelve, has by noon nearly reached the point of the Peninsula of Hindostan, and at one, afternoon, is at the Cape of Good Hope. Here it enters the Atlantic, and travelling northwards, brings high water at the same hours to the western coasts of Africa and the eastern shores of America.

"All these seas, save the Antarctic, have the tides delivered into their mouths at the southern aperture. The Antarctic is the cradle of the tides. It is here that the Sun and Moon have presided over their birth, and it is here also that they are, so to speak, abandoned to the guidance of their own conjointal tendencies. The luminaries continue to travel round the earth, (apparently,) from East to West. The tides no longer follow them. The Atlantic, for example, opens up to them a long deep canal, running from North to South, and after the great tidal elevation has entered the mouth of this Atlantic canal, it moves continually northward; for the second twelve hours of its life it travels North from the Cape of Good Hope and Cape Horn, and at the end of the first twenty-four hours of its existence, has brought high water to Cape Blanco on the West of Africa and Newfoundland on the American continent. Turning now round to the eastward, and at right-angles to its original direction, this great tidal wave brings high water during the morning of the second day, to the western coasts of Ireland and England. Passing round the northern Cape of Scotland, it reaches Aberdeen at noon, bringing high water also to the opposite coasts of Norway and Denmark. It has now been traveling precisely in the opposite direction to that of its genesis, and in the opposite direction also to the relative motion of the Sun and Moon. But its erratic course is not yet complete. It is now traveling from the northern mouth of the German Ocean northwards. At midnight of the second day it is

at the mouth of the Thames, and it is not till the morning of the third day that this wave fills the channels of the Thames, and wafts the merchandise of the world to the quays of the port of London. In the course of this rapid journey, the reader will have noticed how the lines in some parts are crowded together, closely on each other, while in others they are widely asunder. This indicates that the tide wave is traveling with various velocity. Across the Southern Ocean it seems to travel nearly 1,000 miles an hour, and through the Atlantic scarcely less; but near some of the shores, as on the coast of India, as on the east of the American Isthmus, as round the shores of Great Britain, it travels very slowly; so that it takes more time to go from Aberdeen to London than over the arc of 120°, which reaches between 60° of southern latitude, and 60° on the north of the equator. These differences fail to be accounted for; and the high waters are invariably found to exist where the water is deep, while the low velocities occur in shallow water. We must, therefore, look to the conformation of the shores and bottom of the sea as an important element in the phenomena of tides."*

According to Scott Russell's beautiful investigation of what he has called "The wave of the first order, or the great wave of Translation," we have the following rate as the velocity, in seas of given depth, of the great tidal wave considered as a wave of the first order:

Sea,	1	fathom deep,	velocity of	tidal wave,	per hour,	8	miles.
Sea,	10	do.	do.	do.	do.	25	do.
Sea,	20	do.	do.	do.	do.	36	do.
Sea,	36	do.	do.	do.	do.	44	do.
Sea,	40	do.	do.	do.	do.	51	do.
Sea,	50	do.	do.	do.	do.	57	do.
Sea,	60	do.	do.	do.	do.	63	do.
Sea,	70	do.	do.	do.	do.	65	do.
Sea,	80	do.	do.	do.	do.	73	do.
Sea,	90	do.	do.	do.	do.	77	do.
Sea,	100	do.	do.	do.	do.	80	do.
Sea,	200	do.	do.	do.	do.	114	do.
Sea,	400	do.	do.	do.	do.	160	do.
Sea,	1,000	do.	do.	do.	do.	250	do.
Sea,	4,000	do.	do.	do.	do.	500	do.

It will be thus perceived, that there is an especial interest, and a peculiar value attached to deep-sea soundings south of the great "Lands Ends" of Australia, Africa, and America, and it is earnestly hoped that no American man-of-war will pass those regions without taking advantage of every opportunity for trying the depth of the ocean, and doing all in her power to throw light, and diffuse knowledge upon a subject that science in its marches, and man in his progress, have invested with such a degree of interest.

Vessels that are bound around either of the Capes, are recommended to reserve their sounding twine

*See J. Scott Russell on Tides. Division, Hydrology; Johnston's Physical Atlas.

until they get south of the equator. A few casts in mid-ocean on the homeward route from around the Cape of Good Hope, extending all the way up to the equator, and even thence homeward in the North Atlantic, would possess much value. So also those coming from around Cape Horn, as they return homeward, without touching at Rio. They should endeavor to sound at intervals of 250 or 300 miles all the way home, and in both the North and South Atlantic; vessels of the African or Brazil Squadron, should, having regard to the soundings already made, sound at every suitable time and place. They should do this especially in crossing the ocean, on their passage from one station to another, and in going to, and returning from their cruising grounds. But the great field to which the attention of commanding officers is invited, as they pass to and fro, between the United States and their cruising grounds in the Pacific Ocean, China Seas, &c., is South of the parallel of 35° or 40° S. Soundings there, and along their cruising grounds, are particularly recommended to their attention.

With regard to the frequency with which casts should be had for deep-sea soundings, when the ocean is more than 1,000 or 2,000 fathoms deep, it may be remarked, that unless in arms and bights and gulfs and bays, etc., as the Gulf of Mexico and Caribbean sea, it is not generally required to repeat soundings within less than 250 or 300 miles of each other; and that commanding officers may know where soundings have been obtained, I have inserted the table, page 206, which gives all the deep-sea soundings reported up to the time of going to press. When the weather will admit of deep-sea soundings, it is recommended that a boat should be lowered, and having been anchored with a pot, that a sounding should be taken from her. In the South Seas no attempt should be made in blue water, and in unknown depths, South of the parallel of 35° S., without having at least 7,000 or 8,000 fathoms of twine on the sounding reel.

The theory of the tides calls for knowledge as to the depths of the ocean. With all the earnestness admissible, therefore, I venture to press this subject upon the attention of those officers who hold the responsible and honorable position of commanding an American man-of-war. The eyes of the scientific men of the world are upon them, expecting light upon this great physical question.

Among the physical problems of the day, few would by their practical demonstration be considered of higher interest than would the solution of the problem concerning the depths of the ocean. The means of solving that problem have, with a liberality and enlightenment of view beyond all praise, been placed in the hands of American navy officers, and in their hands alone. They are commended by their Government to use these means, and it is their duty to do it, as I am sure it will be their pleasure and their pride. They may expect, therefore, that not only the wise and good men of their own, but the *savans* of all countries have their eyes upon them, and will look with interest for their reports.

Any officer throwing away these rare opportunities of collecting knowledge and information for the use of the world and the good of mankind, or neglecting his bounden duty in the premises, will be held by good men everywhere to a severe public opinion. Therefore, I am earnest in urging this subject upon the attention of every brother officer.

Let us now return to the table of soundings, page 206.

There is a general agreement in the "Albany's" soundings of December 6th and 16th, and the second one

of the 11th. They were made with the line dry and unwaxed. And though it was thought at the time, that soundings were obtained, yet subsequent experiment satisfied both Capt. Platt and Lieut. Taylor, that the results were not to be relied on. I am also well satisfied that the cast was not a good one.

Those soundings, each of about the same duration—27 or 28 minutes—give nearly the same depths and the same rate. See the column Rate, for the rate of fathoms per minute, at which the shot descended. These would seem to repudiate the soundings of December 9th, in which with a 10 pound lead for the weight, 325 fathoms more of line only ran out in one hour and three minutes, than ran out on the 6th, in 27 minutes.

At first these soundings suggested the inquiry; did not the shot reach the bottom on all four of the occasions; and was it not the sweep of the current below, probably the cold current from the North, which theory suggests to be running counter to the Gulf Stream, which continued to take the line from the reel after the shot was landed?

The soundings of December 29th, January 15th, and February 18th, were made with waxed line. Time, depth and rate, all show considerable agreement, notwithstanding there is not a perfect accordance as to circumstances. At the casts of 17 minutes, there was drift—more at the first than at the last.—At the 18 minute sounding, there was no drift, still the rate of descent during the 18 minutes, is less per minute than during either of the two others; which, as the rate is in a decreasing ratio, in consequence of the increased resistance afforded by an increasing length of line, which the shot has to drag after it, shows reasonable conformity.

It is worthy of note, that these three casts were made in that part of the ocean in which Lieut. Walsh discovered that remarkable under-current, which ran off with his barrega, and excited to such a pitch the astonishment of the sailors.

The strain of an under-current would be very great on a great length of line. Persons who are not familiar with the force which a current exerts upon the bight of a rope, as for instance, when the two ends are made fast on opposite banks of a river, and the middle suffered to get into the current—may form some idea of that force by calling to mind the action of the wind upon the string of a kite.

If we imagine still water to be above and below a submarine current intercepted in one of these soundings, it will readily be perceived, how, after the shot has passed through this current, and is still descending, it will have to draw the line after it in the shape of a loop. In this case, the resistance afforded by the line would be greatly increased, and it would go out with whatever rate the shot might have, *plus* twice the rate of the current *nearly*.

Again, when there is both an upper and under-current, but in opposite directions, the shot instead of having to draw the line down as a curved or crooked line, would, if the two currents were equal, have to draw it down as a straight line, but along an inclined plane. In this case, the shot would sink slower, but the line would run faster off the reel than it would were the shot going through still water, and drawing the line off normally. In this case, the effect of the two currents upon the descent of the shot and the rate of the line, would be very nearly as though there were only a surface current, with the joint velocity of the hypothetical upper and lower currents.

If we add to the effect of this supposed surface current, the drift of the vessel also, we shall be ready to appreciate the effect of this motion upon the reel, and the rate at which the twine runs off from it.

Now, if we imagine the shot to have reached the bottom, then the effect would be what those who have attempted these experiments have all witnessed, viz: a continual paying out of the line, and finally a break.

Imagine the effects of an under-current, running no faster even than half a mile an hour, but operating upon the bight of a line some 3,000 fathoms long. The leverage in such a case is immense; it is that so well known to sailors as "swigging off;" and the strain in such a case would be sufficient to part very strong lines.

Hence the value of the check, derived from carefully timing the rate of descent through various depths at every cast;—and of all vessels using the same sized shot for weights, and twine of the same texture, manufacture and kind for the sounding line.

A faithful record of this sort from our men-of-war as they cruise in various parts of the world, will enable us to determine with a degree of probability, not to be easily weakened, as to the relative volocity of the under-currents in different seas, and in various parts of the same sea.

Returning now to a little further consideration of the table of soundings, p. 206, we perceive by running the eye up and down the columns—"Time," "Fathoms," and "Rate"—that in those soundings with waxed lines, (*w*,) of near 7 minutes each, the rate of descent is 80, 86, 88 fathoms, respectively. The 80 fathoms rate being in the Gulf Stream, and being the only one exposed to so rapid a current.

The sea here is, therefore, probably not quite as deep as this sounding would represent it.

The April soundings are from West to East, nearly across the Gulf of Mexico. They appear to be sufficiently accurate to authorize the opinion which has been already expressed, viz: that the basin of the Gulf in the deepest parts is a little over one mile (880 fathoms) in depth. The very deepest part has not yet been probably reached.

The western half of the Caribbean basin is probably not so deep, but its eastern half may be deeper.

Could we obtain with every sounding in these two basins, specimens of the bottom, we might expect to gain light from them and this plan of sounding together, which would enable us to comprehend much more clearly than we now do the system of aqueous circulation of these two basins; we should discover where they are silting up; and with the aid of a microscope, we should probably recognise in one place, deposits brought from the grand South American, and in another, deposites brought from the great North American system of river basins.

The mariner might then hail the geologist and say, "come and see. Here the Amazon and the Orinoco are secretly at work in the recesses of the sea; here, the turbulent Mississippi—and here sub-marine currents are busy in laying the foundations, on a grand scale, of sedimentary formations, which at the next chime of the geological clock are to rise up from the ocean, to bewilder and amaze Geologists with the variety, the extent and the richness of their organic remains: fossil palms and infusoria from the Amazon; reptiles from the Orinoco; birds from the Rio Grande; plants and creepers from the Upper Missouri; pine, beach, and ash from the Mississippi;—heaped up with wrecks of steamers and skeletons of man and beast, will all in the remote future be found imbedded together in the same deposit."

The deep-sea soundings of the Albany are already casting glimmers of light upon our investigations as to the currents of the Gulf of Mexico. The sounding of April the 7th, is significant in this connection.

I had already traced the current that flows through the Yucatan Pass on its way to feed the Gulf Stream, and remarked the sharp turn made by it in the middle of the Gulf near the place of this soundiug. This remarkable elevation in the bottom, would seem in this connection, to indicate that the Mississippi is pushing out its silty barricades to keep back these salt water waves, and to protect its own formations from the violence of this mighty current of the sea.

To say the least, and to speculate no further tham may be necessary to show how rich and inviting is this field, that I may tempt more laborers into it, I may be permitted to remark that no attempt to investigate the currents of the sea, or to comprehend the system of aqueous circulation that is maintained in the ocean, can be crowned with sucess, unless it include in it also the depth and shape of the oceanic basin.

A few ships in the different oceans, with such a corps of observers as the officers of the "Albany" and the "Dolphin" have proven themselves to be, would in a short time enrich our knowledge in this respect, to a vast extent.

Captain Barron to Commodore Warrington.

U. S. Ship John Adams, Maderia, *May 29th*, 1851.

"Sir: I have the honor to report the following "Deep-sea Soundings," viz:

May 3d,—Lat 33° 50′ N., Long. 52° 34′ W. Temp. air 64°; water 65°. Had a fair "up and down" sound with (2600) twenty-six hundred fathoms of line. Time of running out, 1 hour 23 minutes and 10 seconds. One 32 pound shot on the line.

May 9th.—Lat. 32° 06′ N., Long. 44° 47′ W.; Temp. air 66°; water 68°. Got bottom with (5,500) five thousand five hundred fathoms of line out. Time of running out, 2 hours 44 minutes 28 seconds. Drift of ship 3 miles. Lost two 32 pound shot, and 5,500 fathoms of line.

May 10th.—Lat 31° 01′ N., Long. 44° 31′ W. Temp. air 68°, water 68°. Got bottom with (2,300) twenty-three hundred fathoms of line out. Time of running out, 1 hour 4 minutes 35 seconds.

May 17th.—Peak of Pico bearing N. 18° E., distance 24 miles. Found bottom with (670) six hundred and seventy fathoms line. Time of running out, 12 minutes 4 seconds.

May 21st.—Lat. 35° 07′ N., Long. 25° 43′ W. Temp. air 65°, water 64°. (1,040) one thousand forty fathoms line—found bottom. Time of running out, 19 minutes 58 seconds.

We have made frequent other casts, but in consequence of the severe motion, and large drift of the ship, without any satisfactory results."

Captain Barron to Lieut. Maury.

John Adams, at sea, *May 3d*, 1851.

"My Dear Maury—Yesterday for the first time, I had a fair chance at a *deep-sea* sounding, the results which were in every respect satisfactory. The line and reel are quite perfect, having met with no accident

or impediment whatever, for which success we are indebted to—after the markers of the line (Plum & Co.,) and the admirable reel—the hints given us by the experience of Lieut. Taylor in the "Albany;" all of his precautions having been adopted by us. Mr. J. Higgings, our master, is a young man of fine qualifications in his profession, and seems anxious to get at satisfactory results in these experiments. In Lat. 33° 55′ N., Long. 52° 34′ W.; Temp. air 64°, water 65°; we got a fair up and down sound of (2,600) twenty-six hundred fathoms of line—(2,700) twenty-seven hundred fathoms out. Time of running out, 1 hour 23 minutes 10 seconds, *and bottom without a doubt*. It was very nearly a calm, and after hauling in about 100 fathoms of line, it "grew up and down;" the line did not part till we had reeled 400 fathoms, losing 2,300 fathoms of line. The quartermasters and officers are of opinion, that if the ship had been perfectly steady, we might have brought the shot up, but there being considerable swell on, when her stern lifted, and rolled to leeward, she brought such a sudden strain on the line that it snapped. While the shot remained on the bottom, I could draw it along with my naked hand, but so soon as it lifted, I could not move it with a glove on, the weight was so great, and the pain to my hand so severe. One of our quartermasters, as strong a man as we have aboard, could not raise the shot *an inch*, at 2,000 fathoms depth.

I made an effort to get you a cast in the middle of the Gulf Stream, but it was blowing so strong a gale that I found it quite impossible to do any thing. In "luffing to" to take the third reef in our topsails, we ran out a thousand fathoms, but found her drift so much, and the motion so sudden and severe, that we snapped the line. On the 28th April, in Lat. 34° 35′ N., Long. 67° 41′ W., we brought the ship to, and ran out three thousand fathoms of line in one hour, without getting bottom. The line parted, after running all off the reel but about forty fathoms. We have now 5,000 fathoms on the reel, and after getting a few hundred miles deeper into the Atlantic, I shall put on 7,000 fathoms in order to go beyond the greatest depth ever yet attained. Our apparatus is so complete, that I see nothing to prevent it.

May 4th.—Sounded to-day in a calm—line got foul of the rudder, when 2,000 fathoms were out, and parted—put two shot on to the remaining 3,000 fathoms, which ran out rapidly—no bottom—5,000 fathoms line lost to-day.

May 7th.—Weather too rough for sounding till to-day. From the first fair sound, which was "up and down," the officers have become very much interested. To-day we sounded, and got bottom with five thousand and five hundred (5,500) fathoms of line. Time of running out, 2 hours 44 minutes 28 seconds. Lat obs. 32° 06′ N., Long. 44° 47′ W. Drift, 3 miles. Temp. air 66°, water 68°. Used two 32 pound shot. Lost 5,500 fathoms of line. It is difficult for us to say what our up and down sound was. The other sound that I have given you, was almost in a calm, and the sound was "up and down," and no mistake. After the shot took the bottom to-day, the quartermaster held the line in his hand *three minutes* without any difficulty. We all had a feel of it, and it was determined that no line would run off the reel, but that taken off by the ship's drift, and that she would take off by her drift the line as long as we would let it run; but of course *much slower when on the bottom;* this might not be the case, particularly when *checked* for *three minutes*, with the weight of two 32 pound shot attached, and 5,000 fathoms of line out, if it was not on the bottom.

	h. m. s.			m. s.
Cast at	9 22 32			
2,000 fath.	10 2 20	1st 200 fath.	time:	39 48
3,000	10 30 18	3d 1,000 "	"	27 58
4,000	10 59 30	4th 1,000 "	"	29 12
5,000	11 44 30	5th		45 00
5,500	12 7 00	last 500 "	"	22 30

May 10th.—Breeze so light as to be almost a calm; occasional "catspaws" prevented our getting an up and down sound. Got bottom with 2,300 fathoms of line—Lat. 31° 01′ N., Long. 44° 31′ W. Air 68°; water 68°. Time of running out, 1 hour 4 minutes 35 seconds. Drift.—

When we commenced to haul in the last time, I hauled in some four or five fathoms with my naked hands, after getting in some forty or fifty fathoms, the line became as stiff as a bar of iron, and it required the *full strength* of a very stout man to *turn* the *crank* of the reel—of course the line soon parted. We lost 2,200 fathoms.

The last sound which we attempted in a moderate top-gallant breeze, the motion of the ship was so severe, and the drift so considerable, that I found we might easily have lost the whole 7,000 fathoms without a result. This has determined me to husband the 10,000 fathoms of line now remaining for casts, when the prospect for something satisfactory is more promising.

May 17th.—Peak of Pico N. 18° E., distant 24 miles. Sounded in 670 fathoms water; lost the whole quantity of line out.

May 21st.—Lat. 35° 07′ N., Long. 25° 43′ W. Temp. air 65°, water 64°. Found bottom with 1,040 fathoms line. Time of running out, 19 minutes 58 seconds.

May 29th.—Madeira—arrived here day before yesterday—shall sail in one week for Porto Praya, where we shall find Commodore or orders. Expect to return here in October. I have 7,000 fathoms of good line left, and shall give you some soundings along the coast, and perhaps across to St. Helena." * * *

The soundings of the "John Adams" confirm the conjecture of Captain Platt of the "Albany," that he did not get bottom on the 6th and 9th December, for not far from his position on those days Captain Barron, with the experience of the "Albany" to guide him, reports a sounding of 2,000 fathoms—18,000 feet—without bottom.

The great sounding of 5,500 fathoms of May the 7th, corrected for drift, gives, if it be correct, 28,950 feet, as the greatest depth at which the bottom of the ocean has ever been reached. Lieut. Walsh, in the "Taney," went deeper, but he got no bottom.

This sounding of the "John Adams" carries internal evidence of its correctness, at least down to a certain depth. The rate of descent given for the depths of 2, 3, and 4 thousand fathoms, is a decreasing rate and it conforms with the rate of the other soundings generally.

The average rate of descent for the first 2,000 fathoms of this sounding was 50.4 fathoms a minute, whereas the rate of descent for the sounding (2,300) fathoms of May 10th, was only 32 fathoms per minute.

Hence, I infer that the shot—May 10th—had reached the bottom sooner than was expected, for this cast was only 67 miles from that of 5,500 fathoms the day before, and the officers, doubtless, did not expect the shot to reach the bottom so soon. The drift of the ship, probably, continued to take the line out after the shot had reached the bottom, for that it was on the bottom, the great strain felt upon the line leaves no doubt.

My inference is, therefore, that the sea here is *not* 2,300 fathoms deep, while it is nearly twice that depth 60 miles further to the North.

Here is a new feature brought out as to the depths of the ocean, and one which we were not prepared to anticipate; at least I had always supposed that the bottom of the sea generally, was somewhat regular in outline, passing gradually from deep to shallow, and from shallow to deep; that the exceptions are such as we find near the land, being confined mostly to its immediate vicinity, and that the precipices to be found in the depths of the ocean seldom exceed a few hundred feet in descent.

But judging from these two sounding of May 8th and 10th, we perceive that we should not now be surprised if this system of observations should shew that the shape of the Earth's crust at the bottom of the sea is quite as irregular in its outlines, in its elevations and depressions, in its mountains and its valleys, as is the face of our continents.

In this case of the "John Adams," the line, owing to an under current perhaps, and the drift of the ship, continued probably to run out after the shot had reached the bottom. Indeed there is room for the conjecture that the shot reached the bottom, when a little more than 4,000 fathoms of line had been payed out. If we examine the rates above as they are given for each 1,000 fathoms, we find that they have something like a regular ratio of decrease. The 3d 1,000 fathoms took 27 minutes 58 seconds in going out. The 4th 1,000 took 29 minutes 12 seconds. But the 5th 1,000 took 45 minutes, and the last 500 fathoms, or from 5,000 to 5,500, took 22 minutes 30 seconds, or exactly half of what it took the 5th thousand fathoms. The shot was, therefore, probably on the bottom, soon after the 4,000 fathoms had gone out, which would make the ocean here probably about 23 or 25,000 feet deep.

If at this sounding, every 100 or 200 fathoms had been timed as at the deep casts of the Albany in February last, (p. 207,) we should perhaps have been furnished with the means of a more satisfactory conclusion with regard to this interesting sounding.

Commander D. N. Ingraham to Commodore Morris.

U. S. Ship "St. Louis,"

Bay of Spezzia, *Oct.*, 1852.

"Sir:—I have the honor to report I had but one opportunity of taking deep sea soundings, during my passage across the Atlantic.

On the 4th of September, there being a light breeze and a smooth sea, I lowered a boat and sent the sailing master, Mr. Austin, in her, who makes the following report:

1st Cast. Used two 32 lb. shot; the line parted while lifting them over the side of the boat.

2d Cast. Used the patent sounding shot, doubled the line three fathoms, lowered the shot over by another line; it again parted a few fathoms down.

3d Cast. Used one 32 lb. shot; the line doubled three fathoms; the current setting S. S. E., one knot, caused the shot to take the line faster than ordinarily, but by pulling to windward, kept the boat over the shot, and got an up and down sounding 5070 fathoms, (all the line the reel could hold,) no bottom:

Cast at	10h.	00m.	30s.
First 1000 fathoms	10	15	30
2000 "	10	32	30
3000 "	10	54	54
4000 "	11	20	00
5000 "	11	58	40
5070 "	12	10	05

Temperature of the air 77°; water, 78.5°; barometer, 30.09; current, one knot per hour S. S. E.

N. B.—In looking over Commander Barron's report, I find this ship was 4° 8′ north, and 2° 6′ west, of the position where the "John Adams" obtained soundings in 5,500 fathoms.

The sounding from this ship was directly up and down, as the boat was easily kept over the shot by use of the oars; no allowance need be made for stray line. Latitude observed, 36° 16′ N. Longitude observed, 46° 52′ 15″ W."

Commodore McKeever to Lieut. Maury.

U. S. Frigate "Congress,"
Rio de Janeiro, 1 *Oct.*, 1852.

"My Dear Sir:—I enclose several reports, by Lieut. J. P. Parker, of "deep-sea soundings," made by him at various times.

The sounding twine was some that was left here by the "St. Mary's," and is nearly expended, though there is still enough for one or two more experiments. The result of our attempts has not been particularly favorable: there is great difficulty in ascertaining when the shot touches the bottom, after it has taken off a thousand or more fathoms of line. You will see by one of the casts, which required from morning until night, that over 8000 fathoms were run out. I am sorry that we cannot report more satisfactorily upon an experiment requiring so great an expenditure of time and patience. Some of the soundings, however, are satisfactory, and give results which we have every confidence in.

Mr. Parker, my Flag Lieutenant, has given a good deal of atention to the matter, and is fond of occupations of this kind."

Lieutenant J. P. Parker, to Com. McKeever.

U. S. Frigate "Congress," at sea, *April 1st*, 1852.

Lat. 35° 20′ *S.*, *Long.* 51° 30′ *W.* *Bar.* 29.70; *Temp. air* 65°, *water* 69°.

"Sir:—I deem it proper to explain, that since our new sounding reel was fitted with 15,000 fathoms of waxed and carefully marked line, no opportunity of measuring the depth of the ocean has occurred until this noon; when the sea being tolerably smooth, I got out one thousand six hundred and fifty fathoms. The first 1000 fathoms, *fairly up and down.* The drift then became too great for accurate sounding, and when checking the line it parted at about 150 fathoms from the reel. No bottom was reached, and the result cannot be considered satisfactory. The depth, however, is certainly more than 1000 fathoms; which, judging by the formation of the coast, and by the effect produced upon the bed of the ocean by the mighty La Plata, is greater than was anticipated.

Line lost, 1500 fathoms. Time of running out, 36 minutes. One 32 lb. shot used."

Lieutenant J. P. Parker to Commodore McKeever.

U. S. Frigate "Congress," on a Cruise, April 3d, 1852.

Lat. 35° 23′ *S.*, *Long.* 47° 27′ *W.* *Temp. air* 71°. *Water* 68°, *Bar.* 30.10.

"Sir: In obedience to your orders, I repeated to-day the experiment attempted on the 1st inst., to obtain a correct sounding from the ship.

The weather was calm, and the ship, 9.30 A. M. was hove to; but a large long swell gave a considerable surface drift to the northward and eastward. After running off the reel 2,700 fathoms, without reaching bottom, and the drift having become at least a mile, the line was checked and parted about 800 fathoms from the reel. The first 1,000 fathoms went out in 18 minutes; the second 1,000 fathoms in 24 minutes; and the remaining 700 fathoms also in 24 minutes. Whole running time, one hour and six minutes. One 32 lb. shot as weight—1,900 fathoms line lost.

I cannot state with any precision the vertical depth reached, and I am constrained to declare that, from my own limited experience, any accurate measurement of great depths is impossible, from the decks of a ship.

It may not be unworthy of remark that the vast friction of a long line was curiously illustrated in the saving of our 800 fathoms. Two stout men found it hard work to rouse it inboard in half an hour's time."

Lieutenant J. P. Parker to Commodore McKeever.

U. S. Frigate "Congress," Cruizing Edge of Southern belt of Calms,

Lat. 36° 00′ *S.*, *Long.* 44° 11′ *W.*, April 5, 1852.

"Sir: I have the honor to report the results of our experiments yesterday in deep soundings.

After becoming convinced that no reliance could be placed upon deep soundings taken from ship board, you directed that the next should be taken from a boat; and yesterday, at nine A. M., April 4th, I left the ship to carry out your instructions.

At 9h. 26m. 15s. threw over the shot (one 32 lb.) The time was now marked with precision by your secretary, Mr. Glover, who kindly volunteered his services.

At 9h.	28m.	15s.	first	300 fathoms had run out in					3m.	00s.
"	38	00	next	500	fathom mark	run out in			8	45
"	49	00	2d	500	"	"	"	"	11	00
10h.	02	00	3d	500	"	"	"	"	13	00
"	17	00	4th	500	"	"	"	"	15	00
"	36	00	5th	500	"	"	"	"	19	00
11h.	15	00	6th	500	"	"	"	"	37	00

Thus we had three thousand three hundred fathoms out, and, with the exception of the last mark, the elapsed time increased in a tolerable ratio. The sixth 500 mark, however, is out of rule, and would seem like a mistake. But how shall I account for its successor, the next, or 7th 500 fathom length, which took fifty-three minutes to run out? But this is not the worst; for the very next or eighth 500 fathoms run off in twenty-eight minutes of time! Thus: P. M. 12h. 08m. 00 7th 500 fathom mark ran out in 53.00 minutes.
P. M. 12h. 36m. 00 8th 500 " " " " 28.00

During the running of the seventh we stopped two minutes, which strictly should be deducted from the 53m. This was to allow the line to become vertical. A gentle breeze had sprung up from the northward and westward, which continued about half an hour, and the swell from the same direction had increased and become more irregular, which made the boat to wallow uneasily, affecting the free running of the line and giving increased friction to the reel. But all these do not account for the time. If the jump from 19m. to 37m. staggered me, what could I think of the next 53m? Was the line incorrectly marked? Was the shot on the bottom? Every fathom had passed through my hands, and I had received no sensation of striking. The line was checked until it became fairly up and down. May the shot have lodged without concussion upon the side of a steep bank or ridge-like elevation, and gradually rolled itself down, drawing the line *more slowly*, after it?

It had again become dead calm—the sun poured down his hottest rays—the ship had drifted off about a mile from the boat: we spread our awning and continued sounding. The next time (already recorded) was 500 fathoms in 28 minutes. Had the ball here tumbled off the *roof* of the bank?

At 1h.	9m.	15s.	9th	500	fathom mark	ran out in			33m.	15s.
1	44	00	10th	500	"	"	"	"	34	45
2	23	00	11th	500	"	"	"	"	39	00

Here the time is becoming again regularly progressive. The breeze again sprung up—furled the awning, finding it gave too much drift to the boat. Held on to the line five minutes to allow the swag of the line to shorten: the boat was drawn by it to windward at a rate of about one knot per hour! The line became again apparently vertical. We stopped also six minutes after having got out 6,000 fathoms, the boat moving astern as before. These stoppages should strictly be accounted for in the time.

At the end of 6,300 fathoms stopped six minutes, and at 6,500 stopped fourteen minutes. At 6,700

stopped five minutes. At 6,900 stopped six minutes, and at 7,000 fathoms stopped three minutes—the last 100 fathoms taking precisely five minutes to run out.

I continue the table, making no correction for the stoppages:

At 3h.	3m.	30s.	12th 500	fathom mark	out in	39m.	30s.
3	50	00	13th 500	"	"	46	30
4	26	00	14th 500	"	"	36	00
5	10	00	15th 500	"	"	44	00
5	45	00	16th 500	"	"	35	00

The first two of these are nearly regular, but the latter three are not. This may be accounted for by our *feeding* the line from the reel, it now passing out very slowly, but when stopped having the same tension as before, and as before drawing the boat to windward. The stoppages also must be deducted.

At the 75th hundred, stopped 5½ minutes to bring up surface drift. The next one hundred fathoms run out precisely in 5m. 15s. At the 78th hundred, stopped 5 minutes; the last 100 fathoms running out in 5m. 15s. At the 79th hundred stopped 9 minutes. At 5h. 29m. eight thousand fathoms out. At 5h. 33.36—8,100 fathoms.
" 5 41.00—8,200 "
" 5 45.00—8,300 "

It was now sundown, and the breeze freshening, we were compelled reluctantly to stop; though I think no useful result would have been attained by continuing to expend line. Began to rouse in; four men could haul in but 100 fathoms in ten minutes. After getting about 300 fathoms the strain became exceedingly great, and additional force being applied, the line parted about 150 fathoms from the surface.

The boat was drawn rapidly astern at first, but after getting the 300 fathoms, her motion was much slower, and the line trended nearly up and down. It parted finally by a good honest strain, proving itself more trustworthy than I had believed.

After the line parted the men sprang to their oars, and we pulled for the ship, now over two miles off, getting on board rather late and not altogether satisfied with the perplexing results of our long day's work. In fact all we can say truly of our nine hour's patient research "in the deep bosom of the ocean," is that of its depth here we know nothing. The only thing we could congratulate ourselves upon was the unequalled opportunity. No finer day was ever invented by dame Nature for such an experiment; and if our soundings do not show the depth of the ocean bed, perhaps they may indicate some other fact, such as the sweep of the under-current, which may not be without its utility.

But I must here state that I am at variance with my companion, Mr. Glover, on this very point: he being convinced that our soundings were fairly measured, and that the ocean here (allowing only for surface drift) is about 8,000 fathoms, or nearly nine miles deep. As he had the same opportunity as myself to form a correct opinion, and is doubtless equally desirous to obtain the accurate truth, his opinion is entitled to as much weight as my own. I freely confess that I can advance no proof that the shot

did or did not reach bottom; still less that, if it did, the precise time was between 11 A. M. and meridian—though such is my belief, and that the depth was therefore between 3,000 and 3,500 fathoms. There are still difficulties about the several times noted near those meridian measures. Thus the surprising differences noted of 19, 37, 53, and 28 minutes—upon any theory, seem to be almost inexplicable. Much may be due to the effect of the submarine current, the existence of which was proved, I think, by the drag of our line: For, whilst the ship's reckoning gave a surface drift, by current and other causes, of nearly one mile per hour, S. S. E.—for the 24 hours which included our nine hours time, our boat was dragged at the rate of nearly, sometimes fully, a knot and a half per hour, invariably towards the northward and westward whenever the line was checked.

As a speculation, therefore, rather than a fact, I assume that the shot had lodged, at or near meridian; the line passing through the two great oceanic strata, and forming with its long bight, a sort of figure S.—which, as the under current was strongest, probably also thickest, would be gradually more and more, drawn out in its lower loop; that the line therefore would now be drawn out only to feed the two counter streams, and that we might have thus continued indefinitely to expend line without other result.

As we are reporting the longest line yet got out, in sounding with the twine, I am anxious to fairly state my doubts; which perhaps are justified by the configuration of the Eastern shores of the Southern continent; and a belief that no such vast depth as that seemingly obtained, is due to this part of the Atlantic.

But I desire rather to present the facts than to insist upon the argument, and in these there are no substantial differences between myself and Mr. Glover. I hope he may present his views also in writing, that you may form your own conclusions on this remarkable sounding.

I regretted after my first 1,000 fathoms were out that my sinker was not heavier, and having now more confidence in the line, I shall make my next experiment with more weight. One hollow shot with the core filled with lead will perhaps be better than two 32 lb.

I had upon the reel exactly 9,300 fathoms of well waxed and carefully marked twine, and brought back, of course, 1,000 fathoms—besides three or four hundred of the wet stray line roused in at sundown.

The position of the ship on the 4th April, 1852, was as follows: Lat. merid. 35° 35′ S. Long. chro. 45° 10′ W. Temp. air, morning 70°.; evening 67°; Temp. water, morning 69°; evening 70°; Bar. 30.28, morning; 30.14 evening.

	h. m. s.
Whole time of sounding,	8 18 45
Deduct stoppages to plumb the line,	1 19 20
Nett running time,	6 59 25

I would also report the bottles furnished with slips of paper, giving name and position of ship, &c., were, as you directed, carefully corked and sealed, and thrown overboard at noon."

Lieut. J. P. Parker to Commodore McKeever.

U. S. Frigate Congress, April 9th, 1852.

Cruising, Lat. 34° 37′ *S., Long.* 44° 11′ *W., Temp. air* 70°, *water* 69°.

Sir:—I have the honor to report that at 10.30 A. M. I tried another deep sounding from the quarter; the ship being hove to, with the air light from the Northward and Eastward and the sea smooth. As you directed I had one Paixhan shot, with its core filled with lead, weighing then, seventy-one pounds, attached to the line, which for the first one hundred fathoms was doubled. It was then lowered into the water and the time marked. The first 1,000 fathoms run out in 12 minutes—second 1,000 fathoms in 15 minutes; after veering 145 fathoms more, the line parted. Near the end of the 2,000 fathoms length, the drift becoming large, the line was gradually checked by pressing the reel, until it was finally stopped. A taut strain was then obtained, but the trending of the line was but little changed. Now to ascertain if the shot was lodged, the reel was made to revolve rapidly, and the bight at once slacked down in a free scope upon the surface of the water, and only again became taut as the ship sagged to leeward. The same experiment was again attempted when the line parted, apparently by the drift strain, with 2145 fathoms out. The fracture took place about 250 fathoms from the surface; thus about 1,900 fathoms were lost. This line however is of a superior quality and capable of standing a strain or weight one half greater than the line we have heretofore used. It has been marked and reeled up since our sounding of April 4th. I am sorry to say that I can report with no greater certainty than before the depth of this part of the ocean. I can again only offer my opinion; which now is, that our Paixhan shot lodged in near 1800 fathoms water, which would allow for the drift calculated at about half a mile. I am therefore still more constrained to believe that our deep sounding of April 4th was altogether fallacious, and that no such vast depth as then recorded, is due to this part of the Atlantic. However great inequalities doubtless belong to the bed of the ocean, as we see exist upon the land above the sea, and as we are now seventy-six miles distant (north and east) of our former position, the proof is by no means conclusive."

Lieutenant J. P. Parker to Commodore McKeever.

U. S. Frigate "Congress,"

At Sea, April 15th, 1852.

"Sir: I have the honor to report the result obtained by the deep sounding taken this morning.

Nine hundred and fifty fathoms were run out and bottom reached with a fair up and down measurement. One 32 lb. shot used. Time of running, 20 minutes.

This sounding possesses considerable interest from the fact that it was taken only twenty-seven miles outside the bank of the La Plata, where ninety fathoms are the deepest given by the chart.

The position of the ship at meridian (time of sounding) being as follows:—Lat. 34° 50′ S. Long. 51° 40′ W. Distance from Island of Lobos 156 miles. Temp. air 72°; water 70°.

Upon rousing in, the line parted about fifty fathoms from the surface."

Lieut. J. P. Parker to Commodore McKeever.

"U. S. Frigate "Congress," at Sea—May 12th, 1852.

Lat. 28° *S.*, *Long.* 45° 58′ *W.*; *Temp. air* 74°; *water* 76°.

"Sir: I have the honor to report that at 9.30 A. M., a deep sounding was taken, in obedience to your instructions. I regret that I am unable to give the result with any reliable precision. Two thirty-two pound shot were first used and eight hundred fathoms were run out in exactly ten minutes time. The reel was then checked to allow the shot to become plumb, when the line, from some defect, parted about fifty fathoms below the surface. One 32 lb. shot was then attached and the experiment repeated. Fifteen hundred fathoms were taken down, but the reel working slowly and the drift becoming large, a second 32 lb. shot was sent down by a messenger. After checking nearly half an hour to allow the shot to become plumb and the second shot to reach the first, the line was veered to twenty-three hundred fathoms. The shot seemed now to be lodged and the reel was stopped. As the ship drifted the strain gradually increased until the tension became extreme, and the line parted finally one hundred fathoms from the surface. As the angle made by the line during the last stoppage did not vary as in the previous stoppages, and the shot felt as if firmly anchored, I concluded that bottom had been reached; but owing to the drift, as well as to the uncertainty of the exact moment when the shot lodged, the perpendicular measurement can be only vaguely determined. I am quite sure that the first shot was afloat when the second was attached (at 1500 fathoms) and almost equally so that one or both had struck bottom before the line parted. The depth is therefore between 1200 and 2300 fathoms. Perhaps the mean of these would give a fair proximate measurement with sufficient allowance for drift and swag line;—that is nineteen hundred fathoms."

From same to same.

U. S. Frigate "Congress" at Sea—May 13th, 1852.

Lat. 27° 32′ *S.*, *Long.* 47° 08′ *W.*; *Temp. air* 73°, *water* 76°, *Bar.* 30.

"Sir: I have the honor to report the result of our deep-sea soundings of this morning. The first cast was taken with two 32 lb. shot, which struck bottom at three hundred and twenty fathoms. The line parted, upon rousing in, near the surface.

The reel which I had prepared, by your directions, of double line for the purpose of sounding with a lead, was then used, and a pea-shaped lead (12 lbs.) well armed, brought up a specimen of the bottom (coarse, tenacious clay) from the depth of two hundred and eighty fathoms.

This cast was taken with great accuracy. The difference between the two casts may be accounted for by some drift in the first, and by the great velocity of the reel, which took off more line than necessary to measure the depth. As we have neared the land fifty miles since our sounding of yesterday, which was calculated to be 1900 fathoms, I am not prepared to say that our shoal sounding to-day disproves the other; and it is also possible that the last was taken upon a bank, and deeper water may be found nearer the land."

Lieut. J. P. Parker to Commodore McKeever.

U. S. Frigate "Congress," at Sea, June 12th, 1852.

Lat. at noon, 28° 46′ *S.*; *Long.* 43° 46′ *W.*

"Sir: The first favorable opportunity for measuring the depth of the Southern ocean, with the sounding twine received from the Sloop of War St. "Mary's" occurred this morning. The weather being calm and sea smooth I got up the reel, and in obedience to your instructions tried my first cast. One eighteen pound shot was used, as I feared the twine would not sustain a heavier sinker. After running out one thousand fathoms, the reel turning slowly, I attached a second shot of 12 pounds to the line by a messenger, and as the drift was becoming large, I fitted the sounding nipper. A light air springing up soon increased the drift to nearly a mile, and after veering three thousand fathoms the line suddenly slackened as if it had parted. Upon rousing in upon it, however, it was evident that the shot were still attached, and more force being applied the line parted near the nipper. About two thousand and three hundred fathoms of line were lost—which perhaps may indicate approximately the depth of the sea at this point; as it is nearly certain that we had found bottom when the line slackened. As the reel apparatus was imperfect, I did not think it worth while to note the time of running out. It was at 9.30 A. M. when we threw the shot overboard."

From same to same.

U. S. Frigate "Congress," at Sea, August 7, 1852.

Lat. 23° 59′ *S.*, *Long.* 43° 44′ *W.*

"Sir: I have the honor to report, that our proximity to the land made the soundings taken at 10 A. M. not otherwise interesting than as showing the submarine delineation of the coast. After running out about 120 fathoms, the shot (one 32 pounder) suddenly brought up. I estimate the true vertical depth at 90 fathoms. The line parted near the surface."

From same to same.

U. S. Frigate "Congress," at Sea, September 10th, 1852.

Lat. 30° 28′ *S.*, *Long.* 45° 41′ *W.* *Temp. air* 66°, *Water* 68°, *Bar.* 30.05.

"Sir: I have the honor to report the result of "deep sea soundings," taken at noon this day.

It being perfectly calm, and the ship having no perceptible drift, a fair up and down measurement was obtained with the sounding twine and two 32 lb. shot. Bottom was struck at one thousand seven hundred and eighty fathoms (1,780 fathoms.)

Upon attempting to haul in, the line parted at about two hundred fathoms from the reel; the line used, however, is of better quality than any heretofore tried. The moment of the shot striking was noticed, and the line was almost perfectly plumb, so that this is one of the most reliable soundings which have yet been obtained from this ship."

Lieutenant Maury to Commodore McKeever.

NATIONAL OBSERVATORY,
Washington, December 22, 1852.

"SIR: Your obliging letter of 1st October, with its inclosures touching deep-sea soundings, was received yesterday, for which be pleased to accept my thanks, and to convey my acknowledgments to Lieutenant Parker. I am made happy by the interest which you and he take in the solution of the great physical problem concerning the depths of the ocean.

The good work which has been done on board the "Congress" with the "St. Mary's" twine, redounds still more to the credit of Lieutenant Parker; for they of the "St. Mary's" reported that they could make no use of it. That ship was absent nearly three years; she circumnavigated the globe; was furnished with this twine for the express purpose of sounding the deep sea. She made but one attempt: that was a complete failure; and then reported the twine as worthless, and that it would be useless to make any further attempts with it.

It is, therefore, not a little, to the credit of Lieutenant Parker that he should take the twine which had been condemned on board the "St. Mary's," and do such good work with it in the "Congress."

On board the "Congress," Lieutenant Parker reports a sounding of 8,300 fathoms, but discredits the result. I agree with him that there is no evidence afforded by the patient labors of himself and boat's crew on the 5th of April, that such is the depth of the ocean. The shot, no doubt, reached the bottom short of 3,300 fathoms. Indeed, it is probable that it was on the bottom before the 2,800 fathom mark passed out; for to this depth, the running time for 500 fathoms corresponds with the running time for like depths reported by other officers in other parts of the sea.

At this place of sounding there was an under current; for, by the action of it upon the line alone, it towed Lieutenant Parker's boat against a surface current, and the "at the rate of about one knot per hour." Speaking of this under current again, and after he had returned on board the frigate, Lieutenant Parker shows it to be very decided; "For whilst," says he, "the ship's reckoning gave a surface drift, by current and other causes, of nearly one mile per hour S. S. E., for the 24 hours which included our nine hours time, our boat was dragged at the rate of nearly, sometimes fully, a knot and a half per hour, invariably toward the northward and westward whenever the line was checked."

I should have been able to discuss this sounding in a much more conclusive way had each 100 fathom mark been timed. The time is all right by the 500 fathoms, and the sounding appears to be good to the depth of about 2,800 or 3,000 fathoms. After that depth had been reached, the shot probably remained at the bottom. The line then probably parted. Such is the result of experience with a great length of line out and the reel checked. I have no case of any very deep sounding in which the line did not part within a minute or two after the reel was stopped.

Indeed, Lieutenant Parker himself affords testimony as to the immense strain that is brought upon a great length of line, for he says, "Four men could haul in but 100 fathoms in ten minutes. After getting about 300 fathoms, the strain became exceedingly great, and, additional force being applied, the line parted about 150 fathoms from the surface."

Upon the supposition that the shot was on the bottom at 2,800 fathoms, we have an upper current and an under current operating with a swigging, and a powerful swigging force upon the bight of a line more than three miles long. I have no doubt that the line then parted; and that afterwards the line was tailing out to the current, that is, the loose end of the line was drifting along with the current. Consequently, by its yielding below, it lessened the force to take it from the reel above. The line would, therefore, continue to run out slowly until the slack was taken up, or the bight straightened out below, and then it would go out at the rate of the drift current, and undertows combined.

Lieutenant Parker gives the time which it took the first 300 fathoms to run out; after that, he timed the 800, the 1,300 and so on at 500 fathom intervals, up to the 2,800 fathom mark, or the 6th interval, when the time began to run wild.

I can compare Lieutenant Parker's sounding with Lieutenant Taylor's of the "Albany." If we had always the same line, the same weight, and the same conditions of wind and currents, drift, &c., we might expect the time and rate of descent to be very nearly the same in all parts of the ocean. But at one sounding the sea may be perfectly calm without current; at another time the boat may be drifting from under the line, with the current, at the rate of a mile or more an hour. It is, therefore, evident, that equal lengths of line would not run out in equal times on two such occasions.

Bearing this in mind, we can institute the following comparisons with the first 6 times of 500 fathoms each, marked by Lieutenant Parker, and with corresponding times and lengths by Lieutenant Wm. Rogers Taylor of the "Albany."

	ALBANY.					CONGRESS.
	Dec. 15.	Dec. 19.	Feb. 15.	Feb. 16.	Means.	April 5.
	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
From 300 to 800 fathoms	8 29	10 7	8 9	8 8	8 44	8 45
" 800 to 1300 "	10 52	12 20	10 2	9 45	10 45	11 00
" 1300 to 1800 "	12 23	14 23	11 16	11 55	12 29	13 00
" 1800 to 2300 "	13 24	16 13	12 42	14 40	14 15	15 00
" 2300 to 2800 "	14 15	16 32			15 24	19 00

Lieut. Parker probably was not exact with his time, for he gives it only to the even minute This is one cause of discrepancy between him and Taylor. His line was waxed—Taylor's was not: this is another; and the two lines were not of the same manufacture. But it will be observed that Parker's times and marks agree with Taylor's very well until we reach 2,800 fathoms—then Parker takes too much time, and becomes inconsistent with himself. If bottom had not been reached during the interval, the time from 2,300 to 2,800 fathoms would probably have been about 17 instead of 19 minutes. I shall therefore call the ocean here, after allowing for drift, &c., about 2,600 fathoms or 3 miles deep.

Upon the supposition that the lower end of the line for the rest of the time was adrift, and tailing out to

the undertow, we should have an uniform, or nearly an uniform, rate of going out. Let us, therefore, allow for the stoppages, and the drift of the boat by the unequal force of the wind as best we may, we shall then obtain the following tabular statement of this interesting day's work.

	Fathoms.	Time.	
6th	(From 2,800 to 3,300)	37.00 min.	
7th	(" 3,300 to 3,800)	51.00 "	"Stopped 2 minutes." This correction has been applied.
8th	(" 3,800 to 4,300)	28.00 "	A breeze had sprung up.
9th	(" 4,300 to 4,800)	33.15 "	
10th	(" 4,800 to 5,300)	34.45 "	
11th	(" 5,300 to 5,800)	34.00 "	"Held on to the line 5 min." This cor. has been applied.
12th	(" 5,800 to 6,300)	34.30 "	"Stopped 6 minutes." do.
13th	(" 6,300 to 6,800)	21.30 "	(Deducting 3 stoppages of 21 minutes.*) do.
14th	(" 6,800 to 7,300)	27.00 "	"At 6,900, stopped 6 minutes; at 7,000, 3 min." do.
15th	(" 7,300 to 7,800)	38.30 "	"Feeding the line from the reel at 7,800, stopped 5m." do.
16th	(" 7,800 to 8,300)	21.00 "	"Stopped 5 and 9 minutes at 7,800 and 7,900." do.

At the 16th mark, Lieut. Parker says, "It was near sundown, and the breeze freshening." This and the two stoppages can account for the 21 minutes at the 16th time, as well as for that at the 13th.

During each of these times there was a breeze with drift. The observations, therefore, appear to me to be reconcilable, and such as to show that the depth of the ocean in Lat. 36° South, Long. 44° 11′ West, is only about 2,600 fathoms as before stated.

I think that after the above examination of the circumstances of the case, you will concur with Lieut. Parker and myself as to the probability that the shot had reached the bottom by the time 3,000 fathoms had run out. This conjecture has been made probably correct by a discussion of the rate at which the line was taken from the boat. Other evidence, independent of this can be brought, tending to confirm the same.

Lieut. Parker states that the ship was drifted by a surface current "of nearly one mile per hour," and that the boat, whenever he held on to the line, "was dragged at the rate, nearly, sometimes fully, a knot and a half an hour."

I suppose it was through the water and not over the bottom that the boat was dragged at this rate, for an under current of ¾ miles per hour, operating upon the great length of line out, might tow the boat through the water at nearly a knot and a half an hour, provided there were a counter surface current, as in this case there was, of about ¾ knots per hour.

I may remark in passing, that a further account as to the circumstances connected with this under current would have greatly enhanced the value of this interesting day's work.

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*At the end of 6,000 fathoms, stopped six minutes, and at 6,500 stopped 14 minutes; at 6,700 stopped 5 minutes. I suppose these three stoppages are to be deducted from the interval of 46.30; from 6,300 to 6,800 fathoms.—*Lieut. Parker's Report.*

Now let us see, supposing it was a current that took out the line after it had parted and tailed out straight with the 7th length of 500 fathoms out, at what rate it ought to have gone out to a drift which dragged the boat "at the rate of nearly, sometimes fully, a knot and a half an hour."

From the 8th to the 16th time, inclusive, 4500 fathoms line, or about 5 miles (5.11) of the line was taken out of the boat in 4h. 32m. 30s., or at the average rate of nearly one mile and one eighth (1.13) an hour, or 500 fathoms in 30m. 16s.

The boat, says Lieut. Parker, was dragged whenever he held on to the line "at the rate of nearly, sometimes fully, a knot and a half an hour."

Suppose it to have averaged 1¼ knots per hour, the average rate at which the line would have then been taken, would have been 500 fathoms in 27m. 16s., instead of in 30m. 16s. Thus, Lieut. Parker estimates his current to be at a rate which would take off 500 fathoms from the reel in 27m. 16s.; when it actually required 30m. 16s. to take off 500 fathoms.

We may therefore, I think, safely conclude, that if he had have continued his experiments till this time, he would have found his line going out at about the rate of 500 fathoms in 30m.

I should be glad to have the specimen which Lieut. Parker brought up from the depth of 280 fathoms, at his sounding of May 13th. It is described as clay, and no doubt would be considered by Bartlett of West Point, Ehrenberg of Berlin, and other microscopists, as a great treasure. Specimens from the bottom at great depths would be very valuable. Specimens of the ooze (a piece as large as a pea will be ample) which may be brought up on the anchor, or the deep-sea lead, in the harbors and along the coast, would be very acceptable, and I will esteem it as a favor if you will have them procured—properly and carefully labelled —and sent me.

Lieut. Parker would have given additional value to his soundings if he had timed on every occasion every 100 fathom mark, as it went out. Both you and he will readily perceive the importance of timing the 100 fathom marks; for the work of one officer not only thus checks itself, but it serves as a check also upon that of other officers in different parts of the world."

The Basin of the Atlantic—Its shape.

PLATE XIV.

This plate cannot claim by any means to represent correctly the shape of the Atlantic basin, with all of its irregularities. The data from which it has been constructed are exhibited on the Chart; they are the deep sea soundings which have been taken by vessels of the Navy in obedience to the circular order, (page 174;) and all the particulars connected with these soundings have already been given in the Chapter on Deep Sea Soundings.

The little circles over the figures on the plate which represent the soundings, are intended to show by their

centre, the Latitude and Longitude of the soundings with as much accuracy as the scale on which the plate is constructed will admit. Those soundings which have above them and this little circle, a dash with a dot over the middle of it, indicate that at the depth expressed by the figures below, in fathoms of 6 feet to the fathom, there was "no bottom," according to the official report.

The shaded bands represent the one, two, three and four thousand fathom steppes at the bottom of the Atlantic. That is, from the shore to the outer edge of the darkest shading, the sea is less than 1,000 fathoms deep; within the space covered by the next deepest shading, it is between 1,000 and 2,000 fathoms deep; within the space covered by the next shading it is between 2,000 and 3,000 fathoms deep; the lightest shading is intended to show where the ocean is more than 3,000, but less than 4,000 fathoms deep; and where there is no shading, the representation intends to show that the sea is more than 4,000 fathoms deep.

With this explanation it will be perceived that the tracing of these various curves is in many places, and for the most part, matter of conjecture; they can be accurately drawn only where soundings have been actually obtained, and the plate itself shows, therefore, what parts of the curves are drawn from data and what by conjecture—the latter being by far the greater part.

All that is hoped to be accomplished by this plate for the present, is to enable persons to form something like a general idea as to the shape of the Atlantic basin so far at least as the deep-sea soundings returned to this office would enable one to do, and to excite an interest among officers; hoping that with the promise of such interesting results before them, officers will be induced to pay more attention to the subject of deep-sea soundings, and to the order at page 174, which makes it their duty to get casts whenever practicable—than generally they have done.

One of the conclusions which it would seem that we are authorized to draw from thus presenting the results, so far obtained, is this, viz: that if there be any part of the Atlantic Ocean between the banks of Newfoundland and the Equator, more than 5,000 fathoms deep, it is probably no great part in comparison to the whole.

Another feature exhibited as to the shape of this great oceanic basin as represented by plate XIV, is that it is deepest where theory and the projection of the cotidal lines by physicists represent it to be. However it is to be hoped, that the day is not far distant when we shall have deep sea soundings enough to enable us to represent to the nearest 1,000 fathoms at least, the steppes that lead up from the greatest depths of the Atlantic ocean to the shore line. This, it will be observed, one deep-sea sounding in every space of 5° square made by the crossing of the meridians, with the parallels of Latitude on plate XIV, would enable us to do. In other words, one cast for deep-sea soundings in every area on the average of about 75,000 square miles of the ocean, would enable us to give, with considerable accuracy, the depth and shape of this marine basin to the nearest 1,000 fathoms or 6,000 feet. It is therefore hoped that officers when sounding will prefer to make their casts, in those squares represented on the plate, within the limits of which squares no cast has been made.

This plate was drawn by Professor Flye from the data contained in the chapter on deep-sea soundings, page 175. He has also constructed at my request—

FIG. 1—PLATE XV.

Vertical section of the slope and basin of the North Atlantic.

This diagram was constructed to show roughly the elevation of the earth's crust above the sea level, from the Rocky mountains across the Mississippi valley to the Atlantic, and thence the depression of its solid crust below the sea level, across the ocean to the shores of Europe. This section is near the parallel of 39° N.

The section showing the elevation above the sea level of the surface of the land from the Rocky mountains to the Atlantic, is taken from Dr. Drake's work on "The principal diseases in the interior valley of North America," and the section showing the depression of the bed of the ocean below the sea level, is taken from the deep-sea soundings upon which plate XIV is based.

This section confirms the conjecture which these deep-sea soundings suggested soon after they were commenced, and which was mentioned in former editions of this work, viz: That the bottom of the sea is probably much more rugged and abrupt than the surface of the dry land.

Reasons why such should be the case are obvious: on the land, the winds, the rains and rivers are always drifting and washing down the high places and filling up the low: these agents are not felt at all, or, if felt, felt but feebly at the bottom of the deep sea.

On the dry land, frosts and the force of gravity are great levellers. At the bottom of the deep sea no frosts are felt, and the difference of the force of gravity operating upon a rock at the bottom of the sea, and upon the top of a mountain, is as the difference in weight between air and water.

Both of these plates, however, though I do not claim for either of them any minute degree of accuracy, are suggestive.

Barometric Anomalies about the Andes.

Lieutenant Herndon, U. S. N., in his descent of the Andes, on his way in 1851–'2 from Lima to explore the valley of the Amazon, and to descend that river to the Atlantic, determined the heights of various places above the level of the sea, both by Barometric pressure, and by the boiling point of water. His boiling apparatus was constructed by Mr. Wm. Wurdemann, of this city.

His observations as to atmospheric pressure, made with the view of determining heights above the sea level, appear to indicate that the form or shape of the Andes is repeated in the atmosphere. In other words, that there is in the region of the clouds, a ridge or pile of atmosphere, answering to an air-cast mould of the Cordilleras; for at the eastern base of the Andes he found the pressure of the atmosphere, as measured by the temperature of boiling water, to be nearly as great as it is usually at the sea level—and that after having descended the river for nearly a thousand miles below this place of great pressure, he found that, according to the boiling point, he had ascended nearly 1,500 feet!

These mountains extend from three to five miles up into the atmosphere. The Trade Winds blow almost perpendicularly against them. Of course, these winds are obstructed by an obstacle, which extends as far up, or nearly as far up, as they themselves do; and, being thus obstructed in their course, would there not, consequently, be a banking up of air against the Andes, as there is of water against a rock or other impediment over which the current of a rapid river has to force its way? In such cases, there is a ridge or pile of water above the obstruction, and a depression or hollow in the water both above and below this ridge.

Herndon's observations on the boiling point of water, have suggested to me the idea of an air-cast mould of the Andes in the atmosphere; in other words: that there is to windward—that is, to the eastward of the Andes, where the Trade Winds first impinge—an accumulation or ridge of atmosphere, with a valley or depression on each side of it.

To illustrate this, I have had diagram B. of Plate XV, drawn, upon the supposition that the average descent of the Amazon from Chasuta, at the head of uninterrupted navigation, down to the sea, is 8 inches to the mile. Eight inches to the mile is probably too great a descent from the foot of the last rapid in the Amazon to the sea. But the object of the diagram is not to illustrate the slope of the Amazonian water-shed; it is to illustrate the remarkable degree of barometric pressure that has been found near the eastern base of the Cordilleras. I therefore assume the descent of the river to be on the average, very nearly what Herndon's observations made it to be, after he had passed from under the supposed elevation, or ridge of the atmosphere. The distance from Chasuta to the sea is, by the windings of the river, about 3,285 miles.

The dotted line, then, of Fig. B, shows a profile view of Herndon's descent, according to the temperature of the boiling point; and the continuous line, his actual descent, upon the supposition that the average inclination of the river from Chasuta to the sea is as before stated: 8 inches to the mile.

From Nauta, where his boiling point placed him at only 126 feet above the level of the sea, to Egas, where, though drifting down the stream all the way, it placed him 1,715 feet above it, the distance is 707 miles. If intermediate observations could have been made between these two places, he would probably have found that he had passed from under this supposed air-cast range of mountains long before he reached Egas.

However, observations sufficient for a full explanation of the phenomena presented by this diagram are wanting, and we must deal with those we have, as best we may, hoping by calling attention to the subject upon such meagre facts, some other traveller will be provoked into a thorough and complete series of barometric observations along the slopes of the Andes.

Lieut. Herndon assumed that at the mouth of the Amazon, the mean height of the barometer would be 30 in., the boiling point 212°. But during a portion of his descent, the belt of the equatorial calms was over the mouth of the Amazon. All the ships whose Log Books I have with records in them, as to the barometer, show that it does not stand as high in these calms as it does on either side of them. Dewey's observations at Para, confirm this. Therefore Herndon's heights as determined by the boiling point of water during his descent of the Amazon, are probably not so great as the standard to which he referred his observations would make it.

At any rate whether his observations were uniformly too great or too small, is immaterial to my present purpose, which is to show the remarkable variations discovered by him in the pressure of the atmosphere, particularly during his descent of the Amazon.

At Nauta, in Peru, which is about 2,700 miles above the mouth of the Amazon, it appears there was an accumulation of atmosphere sufficient to cause a pressure nearly equal to the ordinary atmospherical pressure at the sea level. In other words, this traveller found himself under a ridge or mountain of atmosphere, the pressure of which away up on the side of the Andes was nearly as great as is the mean pressure of the atmosphere down upon the sea shore.

Drifting along down the river from Nauta, Lieut. Herndon, much to his surprise, found that according to his boiling point, he was ascending or going up-hill quite rapidly, though by the river and his own senses, he was descending. Finally, by his boiling point, at Egas, he ceased to ascend, and again began to descend according to it and his own senses also.

It is worthy of remark, that M. Castelnau, the French traveller, who preceded Herndon, observed the same phenomenon with regard to the high barometer, at Nauta, that the American did with regard to the boiling point.

Their measurements, which were both made on a bluff or high bank of the river, differ from each other as to the height above the sea level, 51 feet. At the next place—Pebas—where they both again observed, the difference between them is 138 feet. At Barra also, they both observed. Here, too, the German travellers, Spix and Martius, observed. These observations give the height of Barra, by Castelnau, 293 feet; by Herndon, 1,380; by Spix and Martius, 522 feet above the level of the sea. M. Castelnau complains that in his descent of the Amazon his barometer got out of order, and that in consequence, he was compelled to reject a portion of his observations. Was it because his barometer made him apparently go *up* hill, as Herndon's boiling point did, when he knew he was going *down* stream?

It is to be hoped, if this should ever meet the eye of that clever French traveller, he will have the goodness to let the world see those rejected observations.

Moreover, it would probably depend upon the season of the year whether barometrical observations along the Amazon, and to the North of it, would detect this supposed repetition of the Andes in the air. When the equatorial calms are upon the Amazon, as for a month or two annually they are, the trade winds do not blow at Nauta or Pebas, consequently there would be no accumulation of air *then*, and from this cause, over those places. But at the other season, when the S. E. trades are felt at Pebas and Nauta, and when they are impinging and pressing against the Andes, I imagine they accumulate and pile up too, and will make the barometer feel the weight of this accumulation. Now, the fact that those travellers passed along the Amazon at different seasons of the year, may *help* to account for this extraordinary difference among their barometrical observations.

Reasoning from these facts and conjectures, I have been led to ask the question—that if there be an *elevation* in the atmosphere to windward of the Andes, ought there not to be a hollow or depression in it to leeward of them also? With the view of getting some light with regard to the answer to this question, I have

sought to ascertain what is the mean height of the barometer at Lima and along the Peruvian coast of South America.

It appears that the mean height of the barometer at Lima is, according to Doctor Unanue, 29.13, (27 *pulgadas*, 4 *lineas*,) with a variation in its range of from 2 to 4 *lineas* ($0^{in.}.18$ to $0^{in.}.37$.)

He says the barometer rises 2 *lineas* in the summer, and falls as much in winter. Assuming the mean height of the barometer at the sea level in Callao to be 30in., Unanue's mean reading would give 765 feet as the height of Lima above the sea.

But according to a level run for the rail road between the two places, the height of Lima above the sea level of Callao, is only 496 feet, and until it was thus run, the height of Lima above the sea was generally assumed at what the barometer would make it, viz: about 750 feet.

The change in the barometric pressure due a height of 496 feet, is one-third of an inch, and this correction being applied to the Lima barometer of Unanue to reduce it to the sea level, would make the mean reading of the barometer at Callao to be 29.46 : thus confirming this conjecture, (so far as these scanty observations go,) that the barometric pressure along this part of the coast, is less than that due its latitude and elevation. Admitting these conjectures to be truths, we derive a practical rule, that the height of a chain of mountains determined by barometric pressure ***depends upon the way the wind blows.***

If the standard for comparison be placed at the foot of the mountain on the windward side, the height of the mountain will appear too great; and if it be placed on the lee side, the height of the mountain will be too low.

Lima is far enough, or nearly far enough, South to be beyond the reach of the diminished barometric pressure due the belt of equatorial calms. But Lima may be under the hollow, or depression caused in the atmosphere by the Andes, or rather in consequence of the obstruction which these mountains oppose to the Trade Winds. The effect of this obstruction, as before explained, is to cause a banking up in the atmosphere on the windward side of the Andes, (as there was found to be over Nauta,) and a depression in the air on their lee side. Whether Lima is under the axis of this atmospherical valley or not, or whether it is on one side or the other of its axis, is a question for actual observation to decide. I shall certainly look for lower barometers in vessels coasting along the shores of Peru, than I would in vessels crossing the same parallels of latitude, but at a considerable distance out to sea.

Upon the same principle, and for the same reason, I should expect to find in Southern Chile and Western Patagonia a bank of atmosphere to windward of the Andes, and a depression to leeward—the lee side in this place being the Eastern, and the windward side the western side—of the Andes.

Now, Lima is in the range of permanent trade winds, and Lieut. Herndon, by assuming the barometer at the sea level of Callao, to be 30.019, would, after leaving that city, make the heights of all places determined by him, from 210 to 380 feet too high with regard to the Pacific, depending, of course, upon the season of the year; for the fluctuations of the barometer here are periodical as well as diurnal.

At Para, at the mouth of the Amazon, where we have a low barometer not from mountain agency, but

from the effect of the equatorial belt of calms upon the barometer, Herndon's heights, except under the remarkable banking up of the atmosphere to the windward of the Andes, are not far from 230 feet too great as compared with the sea level of the Atlantic at the mouth of the Amazon.

Assuming the barometer at the level of the sea, for the mouth of the Amazon, to be on the average 30.019, Lieut. Herndon by the boiling point, which agrees well with direct barometric determinations elsewhere, makes the city of Para to be 255 feet above the level of the sea.

Para is about 90 miles from the sea, in an alluvial country; it is about 15 feet above the mean tide-water level, and if we suppose that the river has thence to the sea a total fall of 10 feet, (more than an inch to the mile,) we should make Para 25 feet above the sea level. It can scarcely be much more than 25 feet, because we know, or rather because we are entitled to assume that the Amazon has no very great rate of descent near its mouth.

Assuming, then, that Para is only 25 feet above the level of the sea, Herndon's mean boiling point at Para, reduced to the sea level, would be equivalent to a mean barometric pressure of 29.64. By the mean of actual barometric observations taken at Para, he makes the barometer at the sea level, supposing Para to be 25 feet only above it, 29.57, his readings being corrected for temperature only.

If the Andes offered no obstruction to the passage of the trade winds—if there were no barometric anomalies resulting from the rising up of this chain of mountains into the air—and if we had a series of accurate barometric readings from Chasuta, (the head of navigation on the Amazon,) down to the sea, we might expect that the elevation above the sea, as determined from such observations, would gradually decrease from the foot of the mountains to the Atlantic.

There would in such a series of measurements be expressed, it is true, upon the resulting heights, the effect of diurnal changes of the barometer; and if the person making the observations were to be occupied for several months in descending the river with his barometer, the agency of the perodical barometric changes would also be peceived by their effects upon his determinations of elevation. I am supposing in this case of imagined barometric heights, that such an observer would have no corresponding observations at the sea-level, and that the height of the barometer at the mouth of the Amazon would be considered a constant.

The mean monthly heights of the barometer at Para, as observed by Dewey in 1846, 1847, and 1848, and till May, 1849, showed an extreme range of *only* 0.41 in., viz: from 30.02, which was the monthly mean for July, 1846, to 29.61, which was the monthly mean for September, 1846.

The fluctuations arising from the monthly barometric changes might give the line of descent along the Amazon, as determined in this way, a wave-like appearance, amounting, perhaps, to 300 or 400 feet at most. But in the case before us, the change actually amounted to something like 2,000 feet. For after Herndon had descended the river 707 miles, and approached with its current the sea level 571 feet, he was then 1,589 feet higher than he was when he set off.

We cannot, therefore, well conceive how we could find from such a source as daily or monthly changes

in the uniform barometric pressure of Para, such anomalies in barometric determinations, heights, and pressures as Fig. B. is intended to illustrate.

If the suggestion that the high boiling point of Herndon and the high barometer of Castelnau at Nauta was caused by the pressure of the trade winds against the Andes, should turn out correct, and the barometric observations on the head waters of the Amazon, both of Humboldt and Condamine, tend to confirm it, will not the Andes be converted into an immense anemometer, by which the force of the trade winds may be determined; and if their force, consequently their velocity also?

The Tides of Sourabaya.

Lieut. Marin Jansen, of the Dutch Navy, has spent much time in the East Indies. Among the various subjects which occupied the attention of this most excellent and accomplished officer, were the Tides of Sourabaya: the northern entrance of which is in lat. 7° 3′ South; long 112° 42′ 30″ East.

Lieut. Jansen, while on a visit to this country on board the "Prince of Orange" frigate in the spring of 1852, was kind enough to communicate to me the following very interesting and valuable paper touching certain tidal anomalies in those straits.

I quote the result of his observations and his remarks for the benefit of mariners.

"*To find the time of highwater on both sides of Straits of Sourabaija. The Eastern entrance*, called "*The Trechter*," (funnel.)

In the eastern entrance to the splendid harbor of *Sourabaija* in the Island of *Java*, there are two channels, one called *the old channel*, the other *Jansen's channel.**

During the whole year, there are every day, two highwaters observed in the *Trechter*, but in most occasions they differ from each other in height.

This difference in highwater is occasioned by a tide-wave, that has only once a day highwater, the time and height of which, alters with the sun's declination. Upon this wave the common lunar tides make their up and down motion.

This diurnal wave makes highwater, in day time when the sun's declination is North, but when it is South the highwater of the diurnal wave is at night. When the sun is on the equator or his declination 0, the diurnal wave disappears, and it attains its maximum when the sun's declension is greatest.

The common Lunar tides, such as we are accustomed to observe in our harbors, give highwater twice a day, and must be placed upon the diurnal wave, in combination with which, the absolute highwater observed in the eastern entrance of the Straits of Sourabaija is formed.

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*So named by order of the Governor General in compliment to Lt. Jansen, by whose labors it was discovered.—M. F. M.

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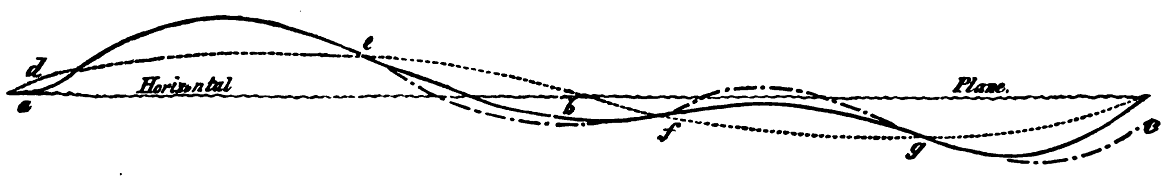
Now it is plain, that if there are two tide waves placed upon each other, whereof, the one is 12 hours above and 12 hours below a horizontal plane, and the other alternatively only 6 hours up, and 6 hours down that level; if one of the 6 hours floods, falls upon a part of the 12 hours diurnal flood, the other 6 hours flood belonging to the same Lunar tide wave, must fall upon the 12 hours diurnal low water, and hence the difference in height between the two observed high waters of the same day.



-------------------- diurnal wave.

— · — · — · — · lunar wave.

———————— observed tide-wave.

From *a* to *b*, is the 12 hours part above the horizontal plane; and *b c*, the 12 hours part of the diurnal wave below this plane; *d e*, the 6 hours part above the diurnal wave; *e f*, the 6 hours below the diurnal wave; *f g*, the 6 hours above the diurnal wave, and *g e*, the 6 hours below the diurnal wave, forming altogether the observed or absolute tidal wave, *a*, *d*, *e*, *f*, *g*.

From the figure it will be easily understood that the highest possible absolute highwater only can take place when the highest water of the diurnal wave and the highest water of the lunar tide happen to fall in the same place, and this can only take place when the sun's declination is greatest; then the diurnal wave is greatest also. For every other time it is only required to know which of the two lunar tides fall upon a portion of that part of the diurnal wave that is above the horizontal plane; and if the time of the highest water of a certain day be required, we consequently know that it must be sought between the limits in time in which the diurnal wave is above the horizontal plane; and further, if those limits be fixed, the highest water will always take place between those fixed limits. But those limits are not fixed; according to one year's observations, they have a monthly retrograding motion, and this is the reason that every month has its own limits.

I have given this explanation, because you know that in our time navigators wish to have the rules explained to them. It is a very fortunate occurrence in navigation that the believers open the way for investigators.

The limits between which the time of the highest water is to be found are in:

March, between noon or		0 hours	and	12 hours.			
April	"	22	"	and	6	"	
Mai	"	22	"	and	4	"	
June	"	20	"	and	3	"	
July	"	18	"	and	3	"	
August	"	16	"	and	2	"	
Septembre	"	12	"	and	0	"	or noon.
Octobre	"	11	"	and	22	"	
Novembre	"	8	"	and	15	"	
Decembre	"	7	"	and	14	"	
January	"	3	"	and	13	"	
February	"	1	"	and	12	"	
March again, between		0	"	and	12	"	

Rule.—To find the time of the highest water for a certain day, take the time of moon's meridian passage for the upper and lower transit of that day and subtract half an hour from both these times. If one of those times fall between the given limits of the month, then this time will be the time of the highest water, and the other transit time will be the time of the smaller high water of that day.

Example.—On a certain day in June, (limits between 20 hours and 3 hours,) for the times of moon's meridian passage are found for the upper and lower transit ± 10 hours and ± 22 hours. Then ± 22 hours lays between the given limits for June, and it will be highest water at ± 21½ hours and the smaller highwater at 10 hours, the other transit time.

Rule.—But if those transit times do not fall between the given limits then that limit number will be the time of the highest water, which is nearest to one of the transit times, and still the other transit time will be the time of the smaller highwater.

Example.—On a certain day in June (limits between 20 hours and 3 hours) the times of meridian passages are found to be ± 4 hours and ± 16 hours, then the highest water will be at 3 hours, because *this* limit number is nearer to ± 4 hours than 20 hours, the other limit number, is to ± 16 hours the other transit time at which the smaller highwater shall take place.

But if, instead of ± 4 hours and ± 16 hours, for the meridian passages was found in the same month ± 6 hours and ± 18 hours, then it should have been highest water at 20 hours, because *this* limit number is nearer to ± 18 hours than 3 hours the other limit number is to ± 6 hours, the other transit time at which the smaller high water shall take place.

From the times of transit in these examples we have seen that the times of highest water jumps from noon to morning, when the moon is in the quarters, and it must be difficult, with reference to the retrograding

motion of the given limits, to know which of the limit number is the time of highest water, when the moon is in the quarters *and the sun near the equator;* but as the diurnal wave disappears when the sun is in the equator, and then both the observed high waters during the same day are equal, there is no difficulty in it, because both the high waters under such circumstances are, for the navigator, equally high.—

The depths in the *Charts of the Channels to Sourabaya* are Rhynland feet, 1 Rhynl'd feet—0.314 metre
1 English feet—0.305 metre

The feet I hereafter mention are always Rhynl'd feet. All the depths in Dutch charts are in those feet or in fathoms of 6 such feet. Every foot has 12 inches.

During the time the sun is in or near the equator the highest water rises with full and change 8 feet, and in the quarters only 6 feet above the depths put in the Chart.

When the sun's declination is the greatest, the highest water rises with full and change 9½ feet, and in the quarters 6½ feet above the depths of the Chart.

The smaller high water rises during the equinox like the other high water 8 feet by full and change, and 6 feet in the quarters; but in the other months it rises above the depths of the Chart:

In May	with full and change	6½ feet	and in the quarters	5½ feet.
June	"	6	"	5
July	"	6½	"	5
August	"	6½	"	5½
Novembre	"	6½	"	5½
Decembre	"	6½	"	5
January	"	6	"	5
February	"	6½	"	5½

The Western entrance to Sourabaija.

This entrance is filled up with a large bank, called "*Zeebank*," (Seabank,) through which there are two channels, one called the *old*—now abandoned—*channel*, the other the *new channel.**

During the months in which the sun is in or near the Equator, in March, April, Septembre, and Octobre, there are with full and change, two high waters every day, but in the quarters, during those months, it is, as in all other months of the year, only once a day high water, which takes place when the sun's declination is north in the day time, and when south at night.

In the following months high water will be found in:

* Discovered by Lieutenant Janson, like that in the eastern entrance, which received his name by an act of the Governor General (of the Dutch East Indian possessions,) and Council, December, 1847.—M. F. M.

May	between	21½	hours	and	0½	hours.
June	"	20	"	"	0½	"
July	"	19	"	"	0	"
August	"	16	"	"	0	"
November	"	10	"	"	12½	"
December	"	8	"	"	12	"
January	"	8	"	"	12	"
February	"	7	"	"	12	"

and because the water rises or falls but very little during one or two hours before and after the time of highest water, a ship can depend upon it to find, during the whole interval between the given times, high water to cross the bank.

Very often the times of the highest water is 22½ hours during the East monsoon (sun's declination North) or at 10½ hours in the West monsoon (sun's declination South.) This is also the case during the months in which there are, with full and change, two tides, but the time of high water is then in general very irregular. The same jumping of the time of high water during the quarters we observed in the Eastern entrance, from noon to morning and backwards, we find here in the Western entrance in the quarters of the months March, April, Septembre and Octobre, but it is very difficult to point out the day in which it takes place. The greatest rise above the depths of the chart is 6½ feet, with full and change in the months that there is only once a day high water. The least rise with full and change near the equinox is 4 feet, in which months the change takes place from high water in daytime to high water at night, and backwards. When during this change the moon is in the quarters, there is only one high water every day, and then the water rises 5 feet, in all the other months it rises in the quarters 5½ feet above the depths of the chart.

In March, April, Septembre and Octobre the water rises also in the quarters 1 foot higher, as with full and change, upon the Zeebank or in the Western entrance to Sourabaya.

M. W. JANSEN,

New York, Mai, 1852. Lieutenant in his Dutch Majesty's Frigate *Prince of Orange.*

The Storm and Rain Chart.

Letter E of the series,—the Storm and Rain Chart,—was commenced for the North Atlantic by Lieutenant Wm. Rogers Taylor, U. S. N., and in his absence at sea in the "Albany," it has been continued by Lieutenant Wm. H. Ball, and in his absence in the U. S. S. "Portsmouth," by Lieutenant George Minor.

The object of these charts is to show the total number of observations that have been discussed for each month in every space of 5° square in the ocean; and then to show for every square and month, the number

of days each in which there was rain, a calm, a fog, thunder and lightning, or a storm, and the quarter from whence it blew.

This series is not yet ready for the press, though a vast amount of labor has been bestowed upon it as well as upon the others.

The manner in which these observations are collected from the quarry of Log-books,—brought together and discussed, and the officers at work upon them, reminds one of the sculptor: any single stroke of the chisel, however well directed, does but little towards developing the figure, which in due time is to stand out from the rude mass upon which he is engaged; so with these observations; any single one, however accurate, is in itself worth but little. It is only by oft-repeated observations, multiplied and brought together in sufficient numbers to express their own meaning, that satisfactory and significant results can be obtained. Then, like the piece of statuary to the repeated touch of the chisel, the charts speak for themselves, and all at once stand out before the compiler, eloquent with facts which the philosopher never dreamed were lurking so near.

Among the various phenomena presented in the course of these investigations, some have pointed to the Moon and suggested the inquiry: Has the declination of the Moon any influence upon the bands of trade winds and calms, by moving the edges of their zones up and down the ocean, or by accumulating an excess of atmosphere, first in one hemisphere, then in the other, according as the declination be North or South?

The Abstract Logs will in the course of time afford observations enough probably to enable me to answer this question, for it is one of those questions to which a satisfactory reply, either in the affirmative or negative, is equally desirable.

The investigation of this problem was assigned to Passed Midshipman Mathews. His researches relate entirely to the Atlantic. Before he had completed it he was ordered away to sea; and I have not had force since to continue them. But I am apprehensive that the true answer to the question will be so masked by the effects of other causes in moving these trade wind bands up and down the ocean, that its purport will not be perceived.

Perhaps the Pacific ocean, when there shall be observations enough made in it, will enable me to put this question to rest.

Plate III is a sample of the Storm and Rain Chart.

As in the other case, so in this: the ocean is divided out into districts of 5° of latitude by 5° of longitude for these investigations, and whatever phenomenon is reported as occurring in one part of a district, is assumed to occur in all parts of that district.

Between each pair of meridians having a space of 5° between them, are 12 lines, for the twelve months, always beginning with December, the first winter month; and horizontally between each pair of parallels for each 5° there are 13 lines, eight of which are for gales from the eight semi-quadrants—one for the calms—one for rain—one for thunder and lightning—one for fogs, and the other for the number of observations called days, which have been observed for each month and district. These last are expressed in figures, (See Plate III,) and the others according to the method of "fives and tallies," already explained for other charts.

Three observations make a day; so, in order to see how many days of observation have been discussed for any month, it is necessary to divide by three the number which stands in the column for the months and on the line marked "days."

The object of this chart was to show the exceptions to what may generally be considered the prevailing condition of the weather at sea, and to determine from what quarter storms are most liable to occur for each month in every district.

It may be that mariners do not *always* record in their logs rain, fog, thunder or lightning. They do always mention gales and calms, and the quadrant whence the wind blows: It may, therefore, be probable that both rains and lightning occur at sea more frequently than it would appear by the charts they do; if so, I have at present no means of knowing. But it may be presumed that mariners generally are not more apt to neglect to mention rains, thunder and fogs, in one part of the ocean than the other, and that therefore, the relative frequency with which they occur may be supposed to be fairly indicated on the chart.

But as the chart is a fair exponent according to the data from which it is constructed, as to the frequency of the phenomena to which it relates, we are bound to give it as much faith and credit in one respect as in another, and therefore, to assume until we have reason to suppose it otherwise, that the occurrence of rain, fogs and lightning, is fairly represented in point of frequency.

The scores designate not the times that it thunders or rains, or blows a gale, but simply the number of days on which such phenomena have been reported to occur; as an example, a gale may be accompanied with fog and rain, thunder and lightning, in which case a score would be made in the appropriate places for each.

The districts represented in Plate III by A, B and C, extend from 30° N. to 45° and from 55° W. to 60° W. Those represented by D, E and F, extend from the equator to 15° N., between the meridians of 25° and 30° W.

This plate also affords matter that is interesting to sailor philosophers.

Examining district F, it appears that rains and calms, and N. W. gales abound from December to May inclusive. That lightning is never seen, nor thunder heard there from April to September, inclusive;—that in October there is an occasional gale from the eastward; and that from June to September may be called a rainless season, during which period there is rarely a calm and never a gale, nor a thunder cloud to disturb the air.

This is because the equatorial calms and their train of atmospherical disturbances have gone up, as shewn per trade wind charts, into district E. The rainy season in E is the dry one of F; It may be said that E has two rainy seasons, one for about $2\frac{1}{2}$ months before August, the other for three months after.

It appears from D, that the rains commence before the calms and continue after them: that from December to March is a rainless period: and that an electric display from the clouds is a rare occurrence at any time of the year in this district.

Now going to A, the first thing that strikes us is the prevalence of fogs, the regularity of precipitation,

the almost total absence of gales in June and July, the scanty rains in the former month, and the abundance of the materials from which these facts are drawn.

Contrasting this with B, we find that July and August are the months which are most exempt from storms and rain, fogs and thunder; that calms rarely occur in January, February, March and April, July and August, October and November.

In district C, storms and rain seldom occur in April, May, June and July. But it is needless to repeat what the chart tells so plainly at a glance. Unavoidable circumstances have conspired to delay the publication of this interesting chart.

The Pilot Charts.

Letter C of the series is a chart of the winds: it shows the point of the compass from which the wind blows in all parts of the ocean, and for every month in the year. The numbers of this series are called the "Pilot Charts," of which the North and South Atlantic, in two sheets, each, and "Coast of Brazil within the Trade Wind Region," in one sheet, and the sixth sheet of the South Pacific, have been published. Several other sheets, both of the Pacific and Indian oceans, are in press. See Plate I, as an illustration of the manner in which the figures for Plate V are obtained.

Sheets of this series are also in hand for the entire Pacific and Indian Oceans. Two, illustrative of the Cape Horn passage, have also been sent to press.

The officers employed upon them from time to time have been Lieutenants Herndon, Dulany, H. N. Harrison, Ball and Forrest; Passed Midshipmen Davenport, Powell, De Koven, Wainwright, Balch, Roberts, De Kraft, Woolley, Jackson, Murdaugh, Semmes, Johnson and Lewis, Brooke, Wells, Terrett, and Professor Benedict.

The "Brazil Pilot" is on a scale, to the square, of 2° of latitude by 1° of longitude, and extends from the equator to 23° South.

The rest of the series, except the Cape Horn Pilots, is on a scale of 5° to a square: that is, the ocean is divided off into districts of 5° of latitude by 5° of longitude. The Pilot Charts, therefore, consist of a number of engraved squares without regard to figure of the earth, with four inscribed concentric circles in each; and in these circles are radii, drawn so as to represent every alternate point of the compass-card: thus; N.; N. N. E.; N. E.; E. N. E.; East; and so on around the compass. See Plate V.

After all the Log-books within reach have been examined, and the observations collated for this letter of the series as in Plate I, the results are collected for each district, arranged according to months, and entered each set in its *wind-rose*, Plate V, as the circumscribed square with its concentric circles and points of the compass is called. These entries are made in such a manner as to show at a glance the prevailing winds for any month in any part of the ocean. Not only so: the navigator sees at a glance how many days of observation have been discussed for each month in any district; and of these he sees the number of times, calms have

been found, and the number of times the winds have been reported as coming from each of the sixteen points of the compass.

Thus, in the wind-rose for the district between 5° and 10° N., 15° and 20° West, and marked A, Plate V, he would observe that in August 705 observations as to the course of the wind had been made here, and 13 as to the calms; *i. e.*, out of $\frac{718}{3}$ days, or parts of days, passed by ships in this district during the month of August of various years, the prevailing condition of the weather for consecutive periods of eight hours duration each, was found to be calm thirteen times; and the winds were observed to blow from E. 4 times;* E. S. E., 17; S. E., 5; S. S. E., 165; S., 280; S. S. W., 171; S. W., 23; W. S. W., 26; W., 8; W. N. W., 2; N W., 1; N. N. W., 2; N. N. E., 1; and the other points 0.

The object has been to get for these charts at least one hundred observations for each month in every square of the ocean; this would require for the three great oceans 1,669,200 observations upon the direction of the winds alone.

In some of the wind-roses, or districts of 5° square, we have obtained more than a thousand observations for a single month; whereas, in neighboring districts and for other months, we are left without a single observation—so limited and marked are the commercial paths over the ocean, according to the seasons.

In the South Atlantic, between the route to and fro around Cape Horn, and the route to and fro around the Cape of Good Hope, there is a part of the ocean of immense extent, that is seldom traversed by any vessel. The pilot charts, therefore, are silent with regard to the winds there.

As the wind is found to blow in any part of any given district or division of 5° square, so it is assumed to blow in all other parts of that district.

The pilot charts, therefore, give us the number of times that the wind, in any part of the ocean, is found in a given number of times to come from each point of the compass; and consequently, by studying the pilot chart, we see the ratio between the number of winds from any one point, and the number of winds from all the other points of the compass.

With such data it is practicable to calculate, according to the doctrine of chances, the track which will give the shortest average passage under canvass from port for any month.

This I have done for the routes generally, between Europe and America; and from the ports of the United States, as far south as the parallel of Rio de Janeiro.

In order to select the best average track, from one place to another, as from the ports of the United States to Rio, or to those of Europe, the pilot charts have been discussed in the following manner:

Blank charts on a scale of 5° to an inch at the equator, Mercator's projection, are constructed and lithographed for the whole ocean, twelve times over, so as to have one complete set for each month.

In every space, of 5° square, a sort of compass-card is drawn as in Plate VI.

In the centre of this card are written two numbers—the upper number shows the times—counting 8 hours as "a time"—the winds have been observed in that square, or the given month, which in this case is July;

*Taking "time" to mean a period of eight hours, or three "times" to make a day.

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(see A—Plate VI;) and the lower number shows the per cent. of "the times" in which calms, according to the number of observations made, and the principles of averages, ought to prevail for as much as 8 hours at a time. Thus, in said square A there have been discussed for the pilot charts, in the month of July, 433 observations, and of these, 8, or 2 per cent. represented calms as the prevailing condition of the atmosphere for that month and part of the ocean.

These two quantities are thus stated in order to enable me as well as those who take the charts for their guide, to form some estimate as to the degree of confidence due, or as to the weight to be attached to, the courses recommended and the routes proposed.

Thus more weight is attached to a course that should be recommended through square A, than to one through square B; because, in A, average results are derived from 433 observations; whereas in B, they depend upon only 21; and calms, it appears, prevail there 11.1 per cent. of the time, which is probably out of proportion.

The object, however, is to show the proportion according to the ratio of per centage, of the winds from each point of the compass, and the per centage by which, according to that showing, a vessel in attempting to sail 100 miles, or any other distance through that square on any given course, would in the average have to increase that distance on account of the average prevalence of adverse winds.

Thus suppose a vessel should wish to sail West through square B in July:—an inspection of the plate will show, supposing the 21 observations give a fair average as to the winds in that square for that month, that 16.5 per cent. of the winds there, are from the West; that 11 per cent. are from W. S. W.; 3.5 from W. N. W.; 16.5 from S. W.; and 5.5 from N. W.; all these winds are adverse for a West course, and consequently, they would compel her to turn off from a West course so as to increase the distance required, 37.4 per cent.

In truth, it appears from those 21 observations, that 49.5 per cent. of all the winds that blow here in July, are between W. and S. S. W., inclusive; that it is calm 11.1 per cent. of the time; and that consequently, it is an unfavorable part of the ocean for a vessel to pass through, that wants to get from Europe to the United States, *i. e.*, that wants to get to the southward and westward; it moreover appears that a vessel would have no difficulty except on account of the calms, in getting to the eastward through this same region.

Again, the square C, which is between two lower parallels, and in which we have the experience of 41 vessels to guide us: a vessel to make a W. S. W. course through this square, in July, would have to contend against 53.7 per cent. of winds directly ahead, with the chances of having to increase her distance 93.7 per cent. Here we again see the prevalence of head winds for vessels bound to the United States, and perceive that it is a bad part of the ocean for a vessel so bound to be in, though there are no calms.

It is thus that the chart for July, for the whole ocean, is filled up from the Pilot Chart, with the per cent. of calms and head winds for each month. This is an operation which involves an immense amount of labor.

This being done, the next step in the process, is to find out the best course for a vessel bound in any other direction, to proceed in any given month.

To do this, it is necessary to find out that track, which, with the average per centum of increased distance on account of head winds, and the increase on account of detour, shall give the shortest distance from port to port—for when that is found, it is called the shortest average route. This route, when thus found, is the route which vessels are recommended in the Sailing Directions to take for the several months, to and from Europe to the Equator, &c.

This is a tedious operation; for a satisfactory solution of this problem is not to be attained, without many trials. For instance, after crossing the meridian of 25° W., bound from Liverpool to New York, it is comparatively easy, in July, as a mere inspection of plate VI shows, to make westing between the parallels of 40° and 45°. But the head winds, and the detour they cause a vessel to make, when she comes to try it, may involve such an increase of distance as to make it better to take the chances by some other route; so that it is not the difficulty of getting through one square alone that has to be considered at a time, but the difficulties of getting through all united.

It may turn out, after this tentative process has been repeated again and again, that when we come to examine and compare such results, we may find two routes widely differing, yet each requiring nearly the same distance to be accomplished. In that case, each track is traced from port to port; the per centage of head winds and detour got at carefully for each square through which it passes, and then in the Sailing Directions the preference is given to that track which is least liable to calms, to adverse currents, and to other collateral drawbacks, perplexities, and delays; and which track also has in its favor the shortest distance, and the greatest number of chances for fair winds.

The centre figures in each square, plate VI, stand as before marked, for the whole number of observations and the per centum of calms. The next figures which are arranged along the inner circle, and the per centum of head winds for the courses on which they stand, and the outer circle of figures express the number of miles that adverse winds will compel a vessel to turn out of the way, if she attempt to sail 100 miles direct on the course on which these figures stand.

Thus it will be perceived, that no navigator can reasonably expect that the new routes which I recommend, are to give the short passages *always*, and in every individual case. They give the shortest passages on the average, and thus offer the best chances for a short passage at all times—that's all. Those chances, as the charts shew, may, and sometimes will, turn up adversely. Thus, a vessel trading to Europe, may be told in the Sailing Directions, that her best route in July passes through square D, and that her course through it, is East. Once in a hundred times, however—and just once in a hundred on the average—the pilot chart to which she is referred for a guide, tells her the wind in that square comes from the East; and she may find it, when she gets there, directly in her teeth:—she may be the unfortunate hundredth vessel; we cannot tell. All that I pretend to tell the navigator in such cases is where he will find the greatest number of chances in his favor, and what is the best route for him to pursue. In like manner, he may be recommended, not to attempt to

stand W. S. W. through C, for then the chances are 54 in a hundred that he will have the wind directly in his teeth; still a vessel may pass through this square 7 times, and each time find, as the chart shews it is possible, though hardly probable she may find, the wind exactly in the opposite direction.

With this full explanation as to the process by which the new routes here recommended are discussed and discovered, the intelligent navigator who adopts them, will perceive that these discoveries and these routes are no matter of opinion with me; but that they are the results of the experience of all the navigators combined, whose observations have been used in the construction of the charts.

In the European voyages I have found not much room for improvement as to routes, except to those ship-masters who are just entering that trade; to them, these charts give all the information as to winds, currents, and routes that is possessed by the oldest and most experienced "Packet Captain."

When navigators generally shall agree to follow these new routes, the average sailing passage between Europe and America will, it is believed, from what has already been done, be considerably shortened.

But the new routes which these charts have suggested to the equator, and which lead through parts of the ocean in which the winds and currents were not so well understood as they are along the tracks to Europe, have been attended with more decided advantage, and the most signal success. Practically, they have brought the markets of India and the southern hemisphere many days nearer to our doors.

The route of all vessels bound into the southern hemisphere, whether their destination be the markets of South America, of the Pacific or Indian ocean, is the same as far as the equator: and these charts have actually shortened the average passage hence to the equator, from two days to two weeks, or more, according to the season of the year; this is shown by the results of actual trial. More than a hundred passages have been made by these charts, and according to the routes prescribed. The average length of passage by the old route from the ports of the United States to the line, is forty-one days. The average passage by the new routes has been so far, for January, 31 days; for February, 25; for March, 27½; April 28½; May, 34, June, 33; July, 40; (by the old route in this month the passage is 48 days,) for August, 41; for September; 39; for October, 37; November, 32, and December, 34, against 38½ by the old route for December.

As I write, I receive the abstract logs of the U. S. S. "Saratoga," (Captain Walker,) and of the merchant barque "Dragon," (Captain Andrew.)

They sailed at the same time, both in the month of September last, (1850;) the "Saratoga" took the old route; went as far as 19° of west longitude; and crossed the equator the forty-second day out. The "Dragon" took the new route; crossed the equator the thirty-fourth day; and had passed the parallel of Rio de Janeiro in 23° S., before the "Saratoga" had reached the line; thus making a gain of 1,500 miles upon her competitor, with a saving that far of ten days or two weeks on the passage.

Thus the importance of the undertaking to collect and embody the experience of every navigator as to the winds and currents of the sea, and so to present the results of all this information, that each may have the benefit of the experience of all, is brought home to our merchants; they reap benefits from it daily. Encouragement is therefore given for the vigorous prosecution of the work.

Upwards of 40,000 sheets of these charts have been distributed, and the demands for them are daily increasing.

The Thermal Charts.

Letter D. of the series, designates the thermal charts; they show the temperature of the surface water of the ocean, wherever and whenever it has been observed. These temperatures are characterized by colors and symbols in such a manner that by a mere inspection of the charts, the temperatures for any one month may be recognized and distinguished from the rest. The scale is Fahrenheit; and the temperatures are put down just as they are given in each Log-book, without any attempt to correct for error of thermometer. The thermal chart of the North Atlantic, compiled by Lieutenant Gantt, in eight large sheets, is published. That of the South Atlantic, constructed by Lieutenant Gardner, upon the same scale, will be out in a few days.

The isothermal lines for 80°, 70° and so on, for every 10° of ocean temperature, have been drawn for each month upon these charts by Professor Flye.

They afford to the navigator and the philosopher, much valuable and interesting information touching the circulation of the oceanic waters, including the phenomena of the cold and warm currents; they also cast light upon the subject of the hyetographic and climatic peculiarities of various regions of the earth; they show that the profile of the coast line of inter-tropical America assists to give expression to the mild climate of Southern Europe, they increase to a marked extent our stock of knowledge concerning the Gulf Stream—that great phenomena of the ocean;—for they show that the warm waters of this stream, as it pursues its course to Europe, have a vibratory motion, so to speak, across its course, like a pendulum slowly propelled by heat on one side, and repelled by cold on the other: It vibrates to and fro with the season, preserving in the mean time a peculiar system of convolutions that calls to mind the graceful wavings of a pennon as it floats gently to the breeze. Indeed, if we imagine the head of the Gulf Stream to be hemmed in by the land in the Straits of Bemini, and to be stationary there, and then liken the tail of the stream itself to an immense pennon floating gently in a current: such a motion as such a streamer may be imagined to have, very much such a motion do these charts show the tail of the Gulf Stream to have.

These charts were prepared for the press in four sets,—each set shewing the temperatures for one season;—but they are published with the temperatures of all four seasons on the same sheet. I have, owing to the numerous official demands upon my time, not yet had an opportunity to study them except in sets for one season at a time,—therefore I cannot give as complete an account of all the facts which they develope, as I shall be able to do when I shall have time and opportunity to give them the close study which their importance claims at my hands.

In 1844 I read before the National Institute, a paper "on the Gulf Stream and currents of the sea." Up to that time but little was known of this "river in the ocean," except that it exists and conveys an immense body of warm water from the Gulf of Mexico through the Straits of Florida into the Atlantic Ocean, thence along the coast of the United States towards the shores of Europe by the way of the Grand Banks. Beyond

this* little or nothing was known with regard to it. But since the appearance of that paper, attention has been very much directed to the Gulf Stream.† The Coast Survey has been at work upon it, and the information collected by that establishment and the officers of the navy, with regard to it, added to that afforded by these charts may be said to exceed in philosophical extent and value all that was previously known about it.

These investigations confirm, to a remarkable extent, the speculations put forth in that paper; they have converted many of the suggestions of theory into philosophical facts, and given increased importance to the views which I had the honor to present in 1844.

In the paper which, as already mentioned, was read before the National Institute 8 years ago, and repeated, by request, before the Association of American Geologists and Naturalists the same year, it was remarked with regard to the Gulf Stream and its counter current, the ice-bearing current from the North:—

"The Gulf Stream, as it issues from the Straits of Florida, is of a dark indigo blue; the line of junction between it and the '*roily*' green waters of the Atlantic, is plainly seen for hundreds of miles. Though this line is finally lost to the eye as the stream goes North, it is preserved to the thermometer for several thousand miles; yet to this day the limits of the Gulf Stream, even in the most frequented parts of the ocean, though so plainly marked, are but vaguely described on our charts. Thousands of vessels cross it every year; many of

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* "Upon a correct knowledge of the force and set of currents in the ocean, often depends not only the safety of vessel and cargo, but the lives all on board; and, owing to the want of this knowledge, hundreds of vessels, thousands of persons, and millions of property are annually cast away or lost at sea.

"I do not intend to occupy the time of members with a recapitulation here of what we do know with regard to ocean currents; that indeed might soon be told; for we know little or nothing of them, except that they are to be met with here and there at sea, many of them sometimes going one way and sometimes another; and that the waters of some of them are colder and of others warmer than the seas in which they are found. That we should have a better knowledge of them, and of the laws which govern them, is not only an important matter to those who follow the sea, or make ventures abroad, but it is also a matter of exceeding interest to all those whose enlarged philanthropy, or ennobling sentiments, prompt in them a desire to diffuse knowledge among their fellows, or in any manner to benefit the human race. The mere fact that this meeting is held at all, is evidence ample and complete that it is composed altogether of such. I therefore submit it as a question for the consideration of the meeting, whether it be not competent for the National Institute to devise and set on foot a plan for multiplying observations and extending our information upon these interesting phenomena. A subject of vast importance in the business of commerce and navigation, the currents of the ocean seem to me to be altogether worthy the attention of this society—a series of well conducted observations upon them would be in perfect unison with the great objects of usefulness for which it was created and now exists, and for which its distinguished members and guests have been invited, and are here assembled from all parts of the country.

"Before such an assemblage of mind and intelligence, it is necessary only to mention the meagre state of our information, even with regard to that great anomaly of the ocean, the Gulf Stream; and there will be—there can be, but one mind, as to the importance of making further observations, and of multiplying facts with regard to it. In simply reminding the society, that all we know of this wonderful phenomenon is contained chiefly in what Doctor Franklin said of it more than 50 years ago, that his facts were collected by chance as it were and his observations made with but few of the facilities which navigators now have, I feel that enough and all has been done that is necessary to be done, in order to impress the Institute with the importance of further observations upon it." * * * * *

—*Paper on the Gulf Stream and currents of the sea. Read before the National Institute, April* 2, 1844, *by M. F. Maury, Lieut. U. S. N.*

†"Linked thus with other geological agents, the currents of the sea cannot fail to present themselves to the mind of the geologist as important and interesting subjects for investigation. How much more so are they in the eyes of the navigator; with him, the source of this coast current is a matter of conjecture, and its cause a mystery. And as to its strength, its fluctuations, and the laws which govern them, his nautical books are all but silent. Nor has the history of navigation recorded the first series of systematic observations upon it.

"Proceeding further into the Atlantic, we find a vast stream of warm water running counter to this. It is the Gulf Stream bound from the Straits of Florida to the Banks of Newfoundland, and thence to the shores of Europe. What its breadth or its depth may be, we know not. We are told indeed that even at the same place it runs sometimes at the rate of two knots the hour, sometimes at five, and we know that it may always be found within certain broad limits, varying in this too at the same place, from 140 to 340 miles. With this

them make their observations upon it; and many more, if invited, would do the same. But no one has invited co-operation;* consequently there is no system, and each one that observes, observes only for himself; and when he quits the sea, his observations go with him, and are to the world as though they had not been. * *

"Supposing the pressure of the waters that are *forced* into the Caribbean Sea by the trade winds to be the *sole* cause of the Gulf Stream, that sea and the Mexican Gulf should have a much higher level than the Atlantic. Accordingly, the advocates of this theory† require for its support 'a great degree of elevation.' Major Rennell likens the stream to 'an immense river descending from a higher level into a plain.' Now, we know very nearly the average breadth and velocity of the Gulf Steam in the Florida Pass. We also know, with a like degree of approximation, the velocity and breadth of the same waters off Cape Hatteras. Their breadth here is about 75 miles against 32 in the 'Narrows' of the Straits, and their mean velocity is three knots off Cape Hatteras against four in the 'Narrows.' This being the case, it is easy to show that the depth of the Gulf Steam off Hatteras is not so great as it is in the 'Narrows' of Bemini by nearly fifty per cent., and that, consequently, instead of *descending*, its bed represents the surface of an inclined plane from the North, *up* which the lower depths of the stream *must* ascend. If we assume its depth off Bemini to be two hundred fathoms, which are thought to be within limits, the above rates of breadth and velocity will give one hundred and fourteen fathoms for its depth off Hatteras. The waters, therefore, which in the Straits, are below the level of the Hatteras depth, so far from descending, are actually *forced up* an inclined plane, whose submarine ascent is not less than ten inches to the mile!

"The Niagara is an 'immense river descending into a plain.' But instead of preserving its character in Lake Ontario as a distinct and well defined stream for several hundred miles, it spreads itself out, and its waters are immediately lost in those of the lake. Why should not the Gulf Stream do the same? It gradually enlarges itself it is true; but instead of mingling with the ocean by broadspreading as the 'immense rivers' descending into the northern lakes do, its waters, like a stream of oil in the ocean, preserve their distinctive character for more than 3,000 miles.

"Moreover, while the Gulf Stream is running to the North from its supposed elevated level at the South, there is a cold current coming down from the North; meeting the warm waters of the Gulf midway the ocean, it divides itself and runs *by the side of them* right back into those very reservoirs at the South, to which thoery gives an elevation sufficient to send out entirely across the Atlantic a jet of warm water said to be more than three thousand times greater in volume than the Mississippi river. This current from Baffin's Bay has not only no trade winds to give it a head; but the prevailing winds are unfavorable to it, and for a great part of

our knowledge of it ends, though more accurate information as to it and its offsets would many a time have saved the mariner from disaster and shipwreck, and even now, would add not a little to the speedy and safe navigation of the Atlantic.

"Though navigators had been in the habit of crossing and recrossing the stream, almost daily, for the space of nearly 300 years, its existence even was not generally known among them, until after Dr. Franklin discovered the warmth of its waters, about 70 years ago. And to this day, the information which he gave us, constitutes the basis, I had almost said the sum and substance of all we know about it."—*Ibid.*

*The Wind and Current Charts have called forth the co-operation here proposed.

†That the Gulf Stream is caused by the trade winds.

the way it is belo wthe surface, and far beyond the propelling reach of any wind. And there is every reason to believe that this polar current is quite equal in volume to the Gulf Stream. Are they not the effects of like causes? If so, what have the trade winds to do with the one more than the other?

"Nay more. At the very season of the year when the Gulf Stream is rushing in greatest volume through the Straits of Florida and hastening to the North with the greatest rapidity, there is a cold stream from Baffin's Bay, Labrador, and the coasts of the North, running to the South with equal velocity. Where is the trade wind that gives the high level to Baffin's Bay, or that even presses upon or assists to put this current in motion? The agency of winds in producing currents in the deep sea must be very partial.

"These two currents meet off the Grand Banks, where the latter is divided. One part of it underruns the Gulf Stream, as is shown by the icebergs which are carried in a direction tending across its course. The probability is, that this 'fork' *continues on towards the South*, and runs into the Caribbean Sea, for the temperature of the water at a little depth there, has been found far below the mean temperature of the earth, and quite as cold as at a corresponding depth off the Arctic shores of Spitzbergen. * * *

"More water cannot come from the equator or the pole than goes to it. If we make the trade winds to cause the former, some other wind must produce the latter; but these, cold currents for the most part, and for great distances, are *submarine*, and therefore beyond the influence of winds. Hence, it should appear that *winds* have little to do with the general system of aqueous circulation in the ocean.

"The other 'fork' runs between us and the Gulf Stream to the South as already described. As far as it has been traced, it warrants the belief that it too runs *up* to seek the so called *higher* level of the Mexican Gulf. * * * * * * *

"Therefore this immense volume of water, in passing from the Bahamas to the Grand Banks, meets with an opposing force in the shape of resistance, sufficient in the aggregate to retard it two miles and a half the minute, and this only in its eastwardly rate. There is, doubtless, another force quite as great, retarding it towards the north, for its course shows that its velocity is the resultant of two forces acting in different directions. If the former resistance be calculated according to received laws, it will be found equal to several atmospheres. And by analogy, how inadequate must the pressure of the gentle trade winds be to such resistance, and to the effect assigned them? If, therefore, in the proposed inquiry we search for a propelling power nowhere but in the higher level of the Gulf, we must admit, in the head of water there, the existence of a force capable of putting in motion and driving over a plain, at the rate of 5 miles the hour, all the waters as fast as they can be brought down by 3,000 such streams as the Mississippi river—a power at least sufficient to overcome the resistance required to reduce from two miles and a half to a few feet per minute, the velocity of a stream that keeps in perpetual motion one-fourth of all the waters of the Atlantic Ocean.

"But, in addition to this, may there not be a peculiar system of laws not yet revealed, by which the motion of fluids in such large bodies is governed when moving through each other in currents of different temperature. That currents of sea-water, having different temperatures, do not readily commingle, is shown by the fact already mentioned: that the line of separation between the warm waters of the Gulf and the cold

waters of the Atlantic is perfectly distinct to the eye for several hundred miles; and even at the distance of a thousand miles, though the two waters have been in contact and continued agitation for many days, the thermometer shows that the *cold water on either side still performs the part of river banks* in keeping the warm waters of the stream in their proper channel.

"In a winter's day off Hatteras, there is a difference between these waters of near 20°. Those of the Gulf being warmer, we are taught to believe that they are lighter; they should therefore occupy a higher level than those through which they float. Assuming the depth here to be 114 fathoms, and allowing the usual rates of expansion, figures show that the middle of the Gulf Stream here should be nearly 2 feet higher than the contiguous waters of the Atlantic. Were this the case, the surface of the stream would present a double inclined plane, from which the water would be running down on either side, as from the roof of a house. As this ran off at the top, the same weight of colder water would run in at the bottom; and thus, before this mighty stream had completed half its course, its depths would be brought up to the surface, and its waters would be spread out over the ocean. Why then does not such a body of warm water, flowing and adhering together through a cold sea, obey this law, and occupy a higher level? If it did, the upper edges of its *cold banks* would support a lateral pressure of at least 100 lbs. to the square foot; and vessels in crossing it, would sail over a ridge as it were; on the east side of which, they would meet an easterly current; and on the west side, a westerly current. * * * * * * * * * *

"The maximum temperature of the Gulf Stream is 86°, or about 9° above the ocean temperature due the latitude. Increasing its latitude 10°, it loses but 2° of temperature. And, after having run 3,000 miles towards the North, it still preserves, even in winter, the heat of summer. With this temperature it crosses the 40th degree of north latitude, and there, overflowing its *liquid banks*, it spreads itself out for thousands of square leagues over the cold waters around, and covers the ocean with a mantle of warmth that serves so much to mitigate in Europe the rigors of winter. Moving now more slowly, but dispensing its genial influences more freely, it finally meets the British Islands. By these it is divided, one part going into the polar basin of Spitzbergen, the other entering the Bay of Biscay, but each with a warmth considerably above ocean temperature. Such an immense volume of heated water cannot fail to carry with it beyond the seas a mild and moist atmosphere. And this it is which so much softens climate there. * * *

"May there not exist between the waters of the stream and their *fluid banks*, always heaving and moving to the swell of the sea, a sort of *peristaltic* force, which, with other agents, assists to keep up and preserve this wonderful system of ocean circulation? * * * * * * * *

"The line of meeting between the waters of the Gulf Stream and the Atlantic is distinct to the naked eye for several hundred miles. This unreadiness of cold and tepid sea-water to commingle has been often remarked upon, and seems to impart to one current the power of dividing and turning others aside. Thus the Gulf Stream bifurcates the Labrador current, one part of which underruns the Gulf Stream, and the other takes a southwestwardly direction along the coast. * * * *

"*It would be curious to ascertain the routes of these under-currents on their way to the tropical regions,*

which they are intended to cool. One has been found at the equator 200 miles broad, and 23° colder than the surface water. Unless the land or shoals intervene, it no doubt comes down in a spiral curve. * *

"What time more fit,—what occasion more suitable than the present, for maturing a plan of operations, and for setting on foot a system of observations upon the Gulf Stream, and its kindred phenomena of the sea."*

Thus, by a process of reasoning and argument, it was shown more than seven years ago that the Gulf Stream, as far as the Banks of Newfoundland, flows through a *bed* of cold water, which cold water performs to the warm the office of *banks* to a river;† and which "cold banks" thus pointed out, were discovered with the deep-sea thermometer by Lieut. George M. Bache, U. S. N., in 1846, while operating in connection with the Coast Survey. They partake so decidely of the character of *banks of a river*, that in the annual reports of the Coast Survey for 1846, and elsewhere, these banks were likened to a "cold wall;" and by Lieut. Bache in his report to the superintendent of the survey, to "a bank of cold water against which the Gulf Stream buts up."‡

It was also theoretically shown that the Gulf Stream actually flows up hill:§

That its bottom is a bed of cold water: ‖

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*From this question may be traced the origin of the undertaking which has resulted in the "wind and current charts." The association appreciating the importance of the subject and the suggestions connected with it, readily came forward and used their influence in behalf of the undertaking. It was remarked to them then:

"Gentlemen here, and good men every where, can do much to aid in this plan by giving it their countenance, and using their influence with masters, by inducing them to send to Washington an abstract of their logs, though it contain only the track of the vessel, with the winds and temperatures. Even this would be valuable, and anything additional would be much more so. Our whalemen do collect, and have it in their power to give much truly valuable information. That which they collect concerns the meteorologist, the naturalist, and others, not less than the navigator and geologist. Indeed the ocean, with its almost unsealed book of mysteries, presents to the votary of science, whatever be the name of his association, a common highway, upon which each society, like every nation, may make its ventures, and return in vessels laden with treasures to enrich the mind and benefit the human race."—*Extract from a Paper on the Currents of the Sea, as connected with Geology, read before the Association of America Geologists and Naturalists, May* 14, 1844—*by M. F. Maury, Lieut. U. S. N.*

†"The cold water on either side, still at the distance of a thousand miles, performs the part of *river banks* in keeping the warm water of the (Gulf) Stream in the proper channel."—*Paper on the Gulf Stream and Currents of the Sea.*

‡"Here on the left we have the main currents of the (Gulf) Stream turned to the eastward by Cape Hatteras, and *butting up against a bank of cold water*, which it overflows."—*Report of Coast Survey*, 1846, *Appendix, No.* 4, *page* 50.

§"It is easy to show that the depth of the Gulf Stream off Hatteras is not so great as it is in the "narrows" off Bemini by nearly 50 per cent., and that consequently, instead of *descending*, its bed represents the surface of an inclined plane from the North, up which the lower depths of the stream *must* ascend. If we assume its depth off Bemini to be 200 fathoms,[1] which are thought to be within limits, the above rates of breadth and velocity will give 114 fathoms for its depth off Hatteras. The waters, therefore, which in the Straits are below the level of the Hatteras depth, so far from descending, are actually forced up an inclined plane, whose submarine ascent is not less than 10 inches to the mile."—*Paper on the Gulf Stream and Currents of the Sea, read before the National Institute by M. F. Maury, Lieut. U. S. N., April* 2, 1844.

[1]Its depth in the Florida Pass has been ascertained by the officers of the United States ship "Albany," Commander Platt, acting under the instructions of Commodore Warrington, to be 500 fathoms. That is, bottom has been obtained at that depth. Whether the Gulf Stream water reaches all the way to the bottom, is another question.

‖"As this," (the warm water of the Gulf Stream made specifically lighter by its temperature,) "ran off at the top, *the same weight of cold water*, would run in at the *bottom*."—*Paper on the Gulf Stream and Currents of the Sea, read before the National Institute, by M. F. Maury, Lieut. U. S. N., April* 2, 1844.

"The Gulf Stream bifurcates the Labrador current; one part of which *underruns* the Gulf Stream."—*Paper on the Currents of the Sea as connected with Geology; read before the Association of American Geologists and Naturalists, May* 14*th*, 1844, *by M. F. Maury, Lieut. U. S. N.*

That it bifurcates a cold stream from the North, near the Banks of Newfoundland, and that one fork of this stream pursues thence, on the other side of the Gulf Stream, a *southwestwardly* course as a current of cold water, for the most part submarine :*

That it is bifurcated by the British Isles :†

And that its surface is a double inclined plane, having the ridge, or line of meeting of the two planes near the axis of the stream—from which the surface water, like the rain from the roof of a house, runs off towards each side.‡

Thus most, if not all the conditions which the study of the subject induced me in 1844 to announce as theoretically to exist, have since, as already remarked, been converted into physical facts by the operations of the Coast Survey, or by the navigators who have been observing in connection with the wind and current charts.

The observations made in 1846 by Lieut. George M. Bache, U. S. N., for the Coast Survey,§ and continued in 1847‖ and 1848¶ by Lieutenants S. P. Lee and Richard Bache upon the deep sea and surface temperatures in and about the Gulf Stream, and confirmed as to the surface temperatures by these charts, as well as by the observations of Lieut. J. C. Walsh, U. S. N., while observing in connection with them in 1850—this mass of careful observations thus collected—all goes to confirm the theoretical suggestions of 1844 with regard to the *cold banks* and currents of cold water over or through which the Gulf Stream finds its way to the northward.

The officers of the Coast Survey already alluded to, announced the banks of the Gulf Stream off the coast of North Carolina and Virginia, to be a "wall of cold water." They also found, as had already been predicted, the water at great depths to be a very low temperature—38° Fahrenheit.

They also found on the surface of the ocean, east of the Gulf Stream, layers or streaks of warm water;

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*"Apparently, in obedience to the laws here hinted at, there is a constant tendency of polar waters towards the tropics, and of tropical waters towards the pole."—*Lieut. Maury on the Gulf Stream.*

"It would be curious to ascertain the routes of these under currents on their way to the tropical regions, which they are intended to cool. One has been found at the equator, 200 miles broad, and 23° colder than the surface water. Unless the land or shoals intervene, it no doubt comes down in a spiral curve; meeting the warm waters of the Gulf midway the ocean, (the cold current) divides itself and runs by the side of them right back into those very reservoirs of the South."—*Ibid.*

†"It finally meets the British Islands. By these it is divided—one part going into the polar basin of Spitzbergen; the other entering the Bay of Biscay."—*Ibid.*

‡"In a winter's day off Hatteras, there is a difference between these waters of near 20°. Those of the Gulf being warmer, we are taught to believe that they are lighter; they should therefore occupy a higher level than those through which they float. Assuming the depth here to be 114 fathoms, and allowing the usual rates of expansion, figures show that the middle of the Gulf Stream here should be nearly two feet higher than the contiguous waters of the Atlantic. Were this the case, the surface of the stream would present a double inclined plane, from which the water would be running down on either side, as from the roof of a house. As this ran off at the top, the same weight of colder water would run in at the bottom; and thus, before this mighty stream had completed half its course, its depths would be brought up to the surface, and its waters would be spread out over the ocean. Why then does not such a body of warm water, flowing and adhering together through a cold sea, obey this law, and occupy a higher level?"

§ *Vide* "Annual Report of the Coast Survey for 1846."

‖ *Vide* "Annual Report of the Coast Survey for 1847."

¶ *Vide* "Annual Report of the Coast Survey for 1848."

it was inferred by them that this warm water comes from the Gulf Stream,—that it sent off a branch in the direction of the Island of Bermuda. It was concluded, therefore, that here was a bifurcation of this stream.

In 1850, Lieut. Walsh, who was sent out in the U. S. schooner "Taney," to make certain observations which Congress had authorized the Secretary of the Navy to have made, in connection with my researches concerning the winds and currents of the sea, found like layers or streaks of warm and cold water, and came to a like conclusion as to this bifurcation or "off-set" of the Gulf Stream.

In a letter giving me an account of his cruise, which was unfortunately interrupted by his vessel proving to be unseaworthy, he says: "We discovered the *hot waters of the Gulf Stream* extending as far East as 72° 10′, in a latitude so far South as 33° 30′. The column of water temperature in the Abstract, from May 23 to 29, while engaged in the search for Ashton Rock, will satisfy you of this interesting and important fact, for you will notice that whenever we reached that longitude in our various tracks between the latitudes of 33° 30′ and 34° North, we experienced a sudden change of as much as 5° and 6° in the surface temperature,—70° to 76°:—this must be a branch or off-set from the Gulf Stream." This "discovery" is claimed by the Coast Survey.

Now, these charts do not show that the temperature of the ocean between these parallels beyond the usual limits of the Gulf Stream is permanently any higher than it is between the same parallels generally, until you approach the coast of Africa. The isotherms of 70° for each month, generally, after leaving the Gulf Stream, stretch off to the Eastward, going up as high in some months, as the parallel of 45°. Recrossing the parallel of 40° North, between the meridians of 15° and 20° W., they then make a sharp turn to the Southward and Eastward, showing all the surface water between these lines and the equator to be permanently 70° and up wards. It is not probable, therefore, that the Gulf Stream can supply such an extent of ocean with its warm waters; nor is it clear that the warm water of the cool and warm streaks, reported as above, comes from the Gulf of Mexico. The cool water is probably the intruder from below; indeed, these charts have revealed a natural process of heating and cooling the surface of the ocean, which I am not aware has been discovered before. It is exceedingly beautiful, and goes far to explain this phenomena of the streaks: when the rays of the sun are operating with their greatest intensity in the northern hemisphere, they then raise the temperature of the equatorial surface of the ocean to the highest pitch. Its waters thus becoming lighter, flow to the north in a gentle surface current of warm water; and this current is probably too feeble to be detected by vessels in the ordinary course of navigation.

Thus the isotherm of 80°, for example, will pass from its extreme southern to its extreme northern declination—near 2,000 miles—in about three months.

Being now left to the gradual process of cooling by evaporation, atmospherical contact, and radiation, it occupies the other eight or nine months of the year, in slowly returning south to the parallel whence it commenced to flow northward. How natural that in flowing north it should go in layers; and in cooling, that some parts should cool faster than the others; also, that the cool water from below should now and then be forced up through the mantle of warm water with which the heat has covered certain parts of the ocean. When

we come down to the lower temperatures—the isotherm of 60° for example—the reverse takes place. In this case, the most rapid motion of this isotherm is due to a movement of the waters from the hyperborean regions.

Between the meridians of 25° and 30° west, the isotherm of 60° in September, ascends as high as the parallel of 56°. In October, it reaches the parallel of 50° north. In November, it is found between the parallels of 45° and 47°, and by December, it has nearly reached its extreme southern descent between these meridians, which it accomplishes in January, standing then near the parallel of 40°. It is all the rest of the year in returning northward to the parallel whence it commenced its flow to the South in September.

Now it will be observed, that this is the season—from September to December—immediately succeeding that in which the heat of the sun has been playing with greatest activity upon the polar ice. Its melted waters which are thus put in motion in June, July, and August, would probably occupy the fall months in reaching the parallels indicated.

These waters, though cold and rising gradually in temperature as they flow south, are probably fresher; and if so, probably lighter than the sea water; and therefore it may be, that both the warmer and cooler systems of these isothermal lines are made to vibrate up and down the ocean by a gentle surface current in the season of quick motion; and in the season of the slow motion, by a gradual process of calorific absorption in the one case, and by a gradual process of cooling in the other.

We have the same phenomena exhibited by the waters of the Chesapeake Bay during the winter.

At this season of the year, the charts show that water of very low temperature is found projecting out and over-lapping the usual limits of the Gulf Stream. The outer edge of this cold water, though jagged, is circular in its shape, having its centre near the mouth of the bay. The waters of the bay being fresher than those of the sea, may therefore, though colder, be lighter than the warmer waters of the ocean. And thus we have repeated here, though on a smaller scale, the phenomenon as to the flow of cold waters from the North, which force the surface isotherm of 60° from latitude 56° to 40° during three or four months.

We have, in the making of ice and in the melting of it again, examples of this irregularity of outline on a still smaller scale. In the freezing of an ordinary pond, the fascicles of ice shoot out, and represent with their spires, the jagged edges, or the cold and warm streaks alluded to. They perfectly illustrate in freezing, the manner in which a gentle current of warm water overflowing a surface of cold water may be supposed to send out its couriers or advance streams ahead; and, in melting, the reverse, or the case of the cold water intruding upon the warmer.

Changes in the color or depth of the water, and the shape of the bottom, &c., would also cause changes in the temperature of certain parts of the ocean, by increasing or diminishing the capacities of such parts to absorb or radiate heat.

From these facts, and in the view which I am induced to take of them, I am lead to infer that the mean temperature of the atmosphere between the parallels of 56° and 40° North, and over that part of the ocean in which we have been considering the fluctuations of the isothermal line of 60°, is at least 60° of Fahrenheit—and upwards, from January to August, and that the heat which the waters of the ocean derive from this source,

atmospherical contact and radiation, is one of the causes which move the isotherm of 60° from its January to its September parallel.

It is well to consider another of the causes which are at work upon the currents in this part of the ocean, and which tend to give the rapid southwardly motion to the isotherm of 60°.

We know the mean dew point must always be below the mean temperature of any given place: and that consequently, as a general rule at sea, the mean dew point due the isotherm of 60°, is higher than the mean dew point along the isotherm of 50°, and this again higher than that of 40°—this than 30°, and so on.

Suppose, merely for the sake of illustration, that the mean dew point for each isotherm be 5° lower than the mean temperature, we should then have the atmosphere which crosses the isotherm of 60°, with a mean dew point of 55°, gradually precipitating its vapors until it reaches the isotherm of 50°, with a mean dew point of 45°. By which difference of dew point the total amount of precipitation over the entire zone between the isotherms of 60° and 50° has exceeded the total amount of evaporation from the same surface.

Now, as a general rule in the Atlantic ocean, and it may be inferred in the Pacific also, the prevailing direction of the winds, to the North of the 40th parallel of North latitude, is from the southward and westward, in other words, it is from the higher to the lower isotherms; passing, therefore, from a higher to a lower temperature over the ocean, the total amount of vapor deposited by any given volume of atmosphere, as it is blown from the vicinity of the tropical towards that of the polar regions, is greater than that which is taken up again. How the land may modify this position is another question. I speak of the rule at sea, not of the exceptions on the land.

Now, then, these investigations have brought out prominently before us the fact, that there is near the tropics, both of Cancer and Capricorn, a belt of calms across the great oceans. That on the equatorial side of these belts, the winds at the surface of the sea blow permanently towards the equator—i. e., they come from a cooler and go to a warmer region; thus increasing their capacity for moisture, and consequently taking up more vapor in this part of their circuit than they precipitate down upon it again.

On the polar side of these calm belts of the tropics, the prevailing direction of the wind on the surface of the ocean is towards the poles—i. e.—from a warm to a colder temperature; and therefore in this part of their circuit these winds must deposite more vapor than they can take up again.

These facts, though they be not new, yet they are pressed by the charts so forcibly upon us, that we are led irresistibly to the theoretical conclusion that the trade-wind regions of the ocean are the evaporating regions, and that as a general rule in all other regions of the world, except the deserts, and a few others, mostly on the land, the evaporation is less than the precipitation, and that the excess is returned by the rivers and the rains in the shape of currents from towards the poles to the evaporating regions of the Torrid Zone;—and that the total amount of rain and river water discharged into the sea, without the limits of the evaporating region, expresses the volume by which the cold currents exceed the warm currents of the sea—designating as cold currents all those which run into the Torrid Zone; and all those as warm, which bring their waters from it.

These charts indicate that upon the ocean, the area comprehended between the isotherms of 40° and 50°

Fahrenheit, is less than the area comprehended between the isotherms 50° and 60° ; and this again less than the area between this last and 70°;—for the same reason that the area between the parallels of latitude 50° and 60° is less than the area between the parallels of latitude 40° and 50°; and they indicate that *theoretically* more rain to the square inch ought to fall upon the ocean between the colder isotherms of 10° difference, than between the warmer isotherms of the same difference.

Thus, to make myself clear: the aqueous isotherm of 50° in its extreme northern reach, touches the parallel of 60° N. Now, between this and the equator there are but three isotherms; 60°, 70° and 80°, with the common difference of 10°. But between the isotherm of 40° and the pole, there are at least five others, viz: 40°, 30°, 20°, 10°, 0°, with a common difference of 10°. Thus to the North of the isotherm 50°, the vapor which would saturate the atmosphere from zero, and perhaps far below, to near 40°, is deposited; while to the South of 50° the vapor which would saturate it from the temperature of 50° up to that of 80°, can only be deposited. At least such would be the case if there were no irregularities of heated plains, mountain ranges, land, &c., to disturb the laws of atmospherical circulation as they apply to the ocean.

Having therefore theoretically at sea, more rain in high latitudes, we should have more clouds: and therefore it would require a longer time for the sun, with his feeble rays to raise the temperature of the cold water, which, from September to January, has brought the isotherm of 60° from latitude 56° to 40°, than it did for these cool surface currents to float it down.

After this southward motion of the isotherm of 60° has been checked in December by the cold, and after the sources of the current which brought it down have been bound in fetters of ice, it pauses in the long nights of the northern winter, and scarcely commences its return till the sun recrosses the equator, and increases its power, as well in intensity as in duration.

Thus we have here, for the first time beautifully developed, the effects of night and day, of clouds and sunshine, upon the currents of the sea. These effects are modified by the operations of more powerful agents which reside upon the land; nevertheless, feeble though those of the former class may be, a close study of the thermal charts will indicate that they surely exist.

Now returning towards the South:—we may on the other hand, infer that the mean atmospherical temperature for the parallels between which the isotherm of 80° fluctuates, is below 80° at least, for the nine months of its slow motion. This vibratory motion suggests the idea that there is probably somewhere between the isotherm of 80° in August, and the isotherm of 60° in January, a line or belt of invariable, or nearly invariable temperature, which extends on the surface of the ocean, from one side of the Atlantic to the other. This line, or band, may have its cycles also, but they are probably of long periods.

Theoretically, such a line ought to be found for any given year, but its place for one entire year may not coincide with its place for another, though the motion of such a belt from year to year would probably be very small.

The observations upon which these charts are founded run through a period of half a century; consequently they show the temperature for the months only, without regard to the year, and therefore they do

not enable us to decide satisfactorily as to the existence of such a belt of uniform, or nearly uniform, ocean temperatures for any one year.

Taking the isotherms of 50° and 60° to illustrate the manner generally, in which the waters of different temperatures run into each other, we shall find that their line of separation is not smooth, but jagged. The line of junction between the warm and cold waters of the sea, is not unlike the sutures of the skull bone on a grand scale. The waters of one temperature are dovetailed and fitted into those of another, in apparently the most irregular manner; but nevertheless, like the sutures of the skull when they come to be examined closely, these lines of articulation clearly indicate traces of symmetry. They have their laws.

Now a vessel,—when waters of marked differences of temperature meet,—that sails along near their line of junction, will come across layers or streaks of water, at one time warmer, at another cooler. Where a jagged point of warmer water is found in one month to thrust itself up into a body of cooler water, perhaps the next month it will be found that this obtruding of the warm water, has disappeared, and given place to the intrusion from the cooler water—of an articulating surface equally irregular in its outlines. Such layers of cooler and warmer streaks of water are generally to be found along that part of the usual sailing route between New York and the north of Europe, which runs with the Gulf Stream.

A better idea as to these irregularities in the temperature of the ocean, cannot be conveyed than by quoting from the logs of a few of the many vessels in that trade, which are co-operating with me in collecting materials for the "Wind and Current Charts," and from which it will be seen that it is by no means an extraordinary occurrence for the water thermometer, in the course of one good day's sail, to pass through a range —up and down—of 50°.

EXTRACT FROM ABSTRACT LOGS.

1850.	Latitude.	Longitude.	Temperature of water.	Change of temperature.	
	° ′	° ′	°	°	
May 6	39.43 N.	64.0 W.	66	+ 20	
7	41.5	62.10	42	— 24	
8	42.20	60.0	41	— 1	
9	40.27	59.15	66	+ 25	
10	41.55	56.10	48	— 18	Ship "Prince Albert," Capt. Meyer,— New York to London, 1850.
11	41.34	52.0	60	+ 12	
12	41.5	50.10	60	0	
13	42.20	46.0	51	— 9	
14	44.10	42.20	68	+ 17	
15	45.20	40.30	62	— 6	

EXTRACTS—Continued.

1850.		Latitude.	Longitude.	Temperature of water.	Change of temperature.	
		° ′	° ′	°	°	
May	9	40.36 N.	67.23 W.	46	— 1	Ship "Ticonderoga," Captain Farran,—New York to Liverpool. 1850.
	10	41.10	63.30	62	+ 16	
	11	41.0	59.32	54	— 8	
	12	41.33	55.44	45	— 9	
	13	41.26	52.8	60	+ 15	
	14	40.52	49.0	64	+ 4	
	15	41.50	47.33	51	— 13	
	16	42.19	47.5	44	+ 3	
	17	43.19	44.34	64	+ 10	
May	27	38.41 N.	70.41 W.	54	+ 3	Ship "Queen of the West," Capt. Hallet,—New York to Liverpool. 1850.
	28	38.56	64.17	78	+ 24	
	29	41.20	59.10	52	— 26	
	30	41.31	55.23	57	+ 5	
	31	44.16	48.34	40	— 17	
June	1	44.16	43.15	57	+ 17	
	2	45.28	30.58	61	— 4	
	3	46.29	35.53	55	— 6	
May	30	40.30 N.	66.5 W.	60	0	Ship "Princeton," Captain Russell,—New York to Liverpool. 1850.
	31	41.45	65.0	42	— 18	
June	1	41.1	63.37	60	+ 18	
	2	40.16	61.41	48	— 12	
	3	41.14	57.37	62	+ 14	
	4	41.49	56.49	64	+ 2	
	7	42.21	50.18	44	— 20	
	9	44.18	42.29	60	+ 16	
	10	44.38	38.42	52	— 8	
	11	46.10	33.57	58	+ 6	
June	13	41.35 N.	52.55 W.	66	+ 4	Ship "Ivanhoe," Captain Knight,—New York to Liverpool. 1850.
	14	42.8	48.21	49	— 17	
	15	43.0	44.39	66	+ 17	
June	10	41.55 N.	51.40 W.	63	+ 13	Ship "New York," Captain Marshall,—New York, to Liverpool. 1850.
	11	41.47	48.20	54	— 9	
June	30	40.29 N.	61.14 W.	62	+ 2	Ship "Roscius," Captain Eldridge,—New York to Liverpool. 1850.
July	1	41.29	59.41	74	+ 12	
	2	41.30	53.20	70	— 4	
	3	41.37	48.38	58	— 12	
	4	41.27	46.14	68	+ 10	

EXTRACTS—Continued.

1850.		Latitude.	Longitude.	Temperature of water.	Change of Temperature.	
		° ′	° ′	°	°	
June	17	42.49 N.	51.50 W.	53	+ 3	Ship "West Point," Captain Allen,—New York to Liverpool. 1850.
	18	43.35	49.20	47	— 6	
	19	45.4	44.0	57	+ 10	
Feb.	6	42.53 N.	52.49 W.	38	— 3	Ship "Philadelphia," Capt. Stotesbury,—New York to Liverpool. 1850.
	7	43.58	48.08	31	— 7	
	8	44.37	43.44	57	+ 26	
Dec.	19	40.46 N.	68.24 W.	46		Royal Mail Steamer "Asia," Captain Judkins, from New York to Liverpool. 1850.
	20	42.55	62.50	50	+ 4	
	21	44.23	56.54	40	— 10	
	22	46.50	51.24	40	0	
	23	48.50	44.55	30	— 10	
	24	50.41	37.52	4	+ 16	
	25	51.22	29.27	52	+ 6	
	26	51.34	20.48	53	+ 1	
	27	51.17	12.59.45	57	+ 4	
Dec.	17	40.10 N.	55.51 W.	68	— 3	Ship "Argo," Captain Crawford,—New New York to Havre. 1849.
	18	42.02	52.30	47	— 21	
	19	42.52	48.48	38	— 9	
	20	43.00	45.40	37	— 1	
	21	42.33	45.26	61	+ 24	

These extracts are taken at random. They will give those who have not access to the charts some idea of the change of temperature in these streaks of cold and warm water. They will also afford a clue as to the frequency with which these cold and warm streaks change their positions.

There is on this route a peninsula or island of cold water, which hangs down into the Gulf Stream like a curtain dropped from the North. Its position, as well as its dimensions, vary. It often covers several degrees in extent—and it affords instances of the greatest and most sudden changes that are known to take place in the temperature of the surface waters of the sea. It is generally found about the parallel of 45°, and the meridian of 50°. Covering frequently an area of hundreds of miles in extent, its waters differ as much as 20°, 25° 30°; and in rare cases, even as much as 35° of temperature from those about it.

These waters, doubtless, come down from the cold regions of the north, and are perhaps in the strongest part of that current.

The bottom of the sea in that region—the Grand Banks—assist, no doubt, in forcing this mass of cold waters to the surface; and the fact that they penetrate far down across the usual track of the Gulf Stream, at

times almost cutting it in two as it were, seems to indicate that their momentum here is greater than the momentum of the warm waters of the Gulf Stream, which they push aside; or it may be that this part of the ocean is very shallow. It would be interesting to ascertain as to this with lead and line.

Between this peninsula of cold water and Newfoundland there is a layer or branch of warm waters; perhaps these are brought there by a bifurcation of the Gulf Stream Here we have clearly and unexpectedly unmasked the very seat of that agent which produces the Newfoundland fogs. It is spread out over an area frequently embracing several thousand square miles in extent, covered with cold water, and surrounded on three sides, at least, with an immense body of warm. May it not be that the proximity to each other of these two very unequally heated surfaces out upon the ocean would be attended by atmospherical phenomena not unlike those of the land and sea breezes? These warm currents of the sea are powerful meteorological agents. I have been enabled to trace in thunder and lightning, the influence of the Gulf Stream in the eastern half of the Atlantic as far North as the parallel of 55° N.; for there in the dead of winter, a thunder storm is not unusual.

Reviewing now what has been said concerning the layers of cold and warm water along the European route of the Gulf Stream, and returning to the cool and warm streaks mentioned by Lieut. Walsh, and claimed by the Coast Survey as the discovery of a "branch" from the Gulf Stream; it appears probable that the warm waters which they encountered, and reported as coming from the Gulf Stream, are the warm waters properly due the latitude, and the effect of the South America shore line as far as Cape St. Roque, in sending North, its warm waters. The difference of temperature may be partly due, also, to the warm waters of the surface being separated into streaks by the cooler waters of the submarine current which by the agitation of the ocean are here and there brought to the surface through the thin layer of warm surface water.

If we draw a line of a degree or two in breadth from the capes of the Chesapeake and the Delaware Bays towards Cape St. Roque in Brazil, we shall find in this direction, after crossing the Gulf Stream, a remarkable layer of cold water. This layer extends to the equator, and it is more clearly marked at some seasons of the year than at others:—so much so that I have been at a loss to account for it. Like an immense lake, it is surrounded with water of a higher temperature. It cannot therefore be brought there by a cold surface current. It is strictly a *layer*, in contradistinction to a current.

The only idea that has suggested itself in explanation of this phenomenon is in the conjecture that there may be stretching off in this direction, a submerged mountain range or ridge at the bottom of the sea, across which the cold waters of this submarine current, as it forces itself down towards the equator, are brought to the surface by the agitation of the waves.

Standing out like peaks in this range are the islands of Fernando de Noronha, the Penedo de San Pedro, and the Bermudas. The islands and mountains of Cuba occupy a position which a mountain spur from this sunken range might be supposed to occupy.

Lieut. Walsh, in the "Taney," was directed to run across this supposed submarine range of mountains a zig-zag line of deep-sea soundings from the equator to the capes of Virginia. But unfortunately his schooner proved unseaworthy, and he had to abandon this interesting part of his work.

Capt. Powell, of the U. S. S. "John Adams," in 1850, found himself on a shoal in the South Atlantic, and the fact was first made known entirely by the change in temperature of the surface water. Finding the water to become cool, he got a cast of the deep-sea lead, and found bottom. These facts, as far as they go, give some sort of plausibility to the conjecture, concerning this streak of cool water. Lieut. Commanding S. P. Lee, of the "Dolphin," has instructions thoroughly to investigate this question of depth.

The isotherms of 60°, 50°, and 40°, take a northeastwardly direction across the Atlantic and show the waters of the ocean to be as warm, indeed warmer, between latitude 60° and 65° off the shores of Europe, than they are on this side near the parallels of 40° and 45°.

That the Gulf Stream is roof-shaped: that is, it is higher in the middle and lower at the edges—and that it has a roof-current running from the middle or axial line to either edge, as suggested in 1844, has been proved by experiments since made with regard to it, by officers of the navy.

Thus, in lowering a boat to try a current, they found that the boat would invariably be drifted towards one side or other of the stream, while the vessel herself was drifted along in the direction of it. Now were it possible to make a vertical section across the Gulf Stream, the top of it would appear convex, and the bottom concave, unless where the bottom of it reaches the bottom of the sea.

This feature of the Gulf Stream, throws a gleam of light upon the *locus* of the Gulf weed, by proving that its place of growth cannot be on this side (west) of the middle of that stream. No Gulf weed is ever found west of the axis of the Gulf Stream; and, if we admit the top of the stream to be higher in the middle than at the edges, it would be difficult to imagine how the Gulf weed should cross it, or get from one side of it to the other.

The inference, therefore, would be, that as all the Gulf weed which is seen about this stream is on its eastern declivity, the *locus* of the weed must be somewhere within or near the borders of the stream, and to the east of the middle. And this idea is strengthened by the report of Captain Scott, a most intelligent shipmaster, who informs me that he has seen the Gulf weed growing on the Bahama Banks. I have specimens of it which he had the kindness to send me, with seed vessels, plucked up from the bottom while at anchor on the edge of the Gulf Stream. Hence we account for the fact that the Gulf weed should be seen on the eastern and not on the western borders of the Gulf Stream.

A study of the Thermal Charts will reward the student with new and better ideas as to the system of oceanic circulation. Plate VII exhibits the mean geographical position of the isotherms for various degrees of Fahrenheit from 80° down for each month. These lines are taken from the Thermal Charts, series D.

Let us take the isotherm of 80° for September as an illustration:—the greatest effect of the solar heat is produced upon the land during the month of August; but this chart shows that it is September before the North Atlantic Ocean is fully supplied with its annual store of heat for the winter.

We see clearly enough by the monthly isotherm for 80°, that the western half of the Atlantic Ocean is heated up, not by the Gulf Stream alone, as is generally supposed, but by the great equatorial cauldron to the west of longitude 35°, and to the north of Cape St. Roque, in Brazil. The lowest reach of the 80° isotherm for September—if we except the remarkable equatorial flexure which actually extends from 40° to 2° N., and

rises up again to 35° N.—to the west of the meridian of Cape St. Roque is above its highest reach to the east of that meridian. And now that we have the fact, how obvious, beautiful and striking is the cause!

Cape St. Roque is in 5° S. Now study the configuration of the Southern American continent from this Cape to the Windward Islands of the West Indies, and take into account also, certain physical conditions of these regions:—The Amazon always at a high temperature because it runs from West to East, is pouring an immense column of warm water into this part of the ocean. As this water and the heat of the sun raise the temperature of the ocean along the equatorial sea-front of this coast, there is no escape for the liquid element, as it grows warmer and lighter, except to the North. The land on the South prevents the tepid waters from spreading out in that direction as they may do to the east of 35° W., for here there is a space about 18° of longitude broad in which the sea is clear both to the North and South.

They must consequently flow North. A mere inspection of the thermal chart is sufficient to make obvious the fact, that the warm waters which are found East of the usual limits assigned the Gulf Stream, and between the parallels of 30° and 40° N. do not come from the Gulf Stream, but from this great equatorial cauldron, which Cape St. Roque blocks up on the South, and which forces its overheated waters up to the 40th degree of North latitude, not through the Caribbean sea and Gulf Stream, but over the broad surface of the left bosom of the Atlantic ocean.

Here we are again tempted to pause and admire the beautiful revelations which in the benign system of terrestrial adaptation, these researches unfold and spread out before us for comtemplation. In doing this, we shall have a free pardon from those at least who delight "to look though nature up to nature's God."

What two things in nature can be apparently more remote in their physical relations to each other, than the climate of western Europe and the profile of a coast line in South America? Yet this chart reveals to us not only the fact that these relations between the two are most intimate, but makes us acquainted with the arrangements by which such relations are established.

The barrier which the South American shore line opposes to the escape on the South, of the hot waters from this great equatorial cauldron of St. Roque, causes them to flow North, and, in September, as the winter approaches, to heat up the western half of the Atlantic Ocean, and to cover it with a mantle of warmth above summer heat as far up as the parallel of 40°. Here heat to temper the winter climate of western Europe is stored away, as in an air chamber to furnace-heated apartments; and during the winter, when the fire of the solar rays sinks down, the westwardly winds and eastwardly currents, are sent to perform their office in this benign arrangement. Though unstable and capricious to us they seem to be, they nevertheless "fulfil His commandments" with regularity, and perform their offices with certainty. In tempering the climates of Europe with heat in winter, that has been bottled away in the waters of the ocean during summer, they are to be regarded as the flues and the regulators for distributing at the right time, and at the right places, in the right quantities.

By March, when "the winter is passed and gone," the furnace which had been started by the rays of

the sun in the previous summer, and which, by autumn, had heated up the ocean in our hemisphere, has gone down. The cauldron of St. Roque, ceasing in activity, has failed in its supplies, and the chambers of warmth upon the northern sea, having been exhausted of their heated water, which has been expended in the manner already explained, have contracted their limits. The surface of heated water which, in September, was spread out over the western half of the Atlantic, from the equator to the parallel of 40° North, and which raised this immense area to the temperature of 80°, and upwards, is not to be found in early spring on this side of the parallel of 8° N.

The isotherm of 80° in March, after quitting the Caribbean sea, runs along parallel with the South American coast, towards Cape St. Roque, keeping some 8° or 10° from it. Therefore the heat dispensed over Europe from this cauldron falls off in March. But at this season, the sun comes forth with fresh supplies; he then crosses the line and passes over into the northern hemisphere; and the charts shew that the process of heating the water in this great cauldron for the next winter is now about to commence.

In the meantime, so benign is the system of cosmical arrangements, another process of raising the temperature of Europe commences. The land is more readily impressed than the sea, by the heat of the solar rays: at this season then, the summer climate due these transatlantic latitudes is modified by the action of the sun's rays directly upon the land. The land receives heat from them, but instead of having the capacity of water for reserving it, it imparts it straightway to the air, and thus the proper climate, because it is the climate which the Creator has, for his own wise purposes, allotted to this portion of the earth, is maintained until the marine cauldron of Cape St. Roque is again heated and brought into the state for supplying the means of maintaining the needful temperature in Europe during the absence of the sun in the other hemisphere.

In like manner the Gulf of Guinea forms a cauldron and a furnace, and spreads out over the South Atlantic an air chamber for heating up in winter, and keeping warm, the extra-tropical regions of South America. Every traveller has remarked upon the mild climate of Patagonia and the Falkland Islands.

"Temperature in high southern latitudes," says a very close observer who is co-operating with me in collecting materials for the charts, "differs greatly from the temperature in northern. In southern latitudes there seems to be no extremes of heat and cold as at the North.

"Newport, R. I., for instance, latitude 41° N., longitude 71° W., and Rio Negro, latitude 41° S., and longitude 63° W., as a comparison:

"In the former, cattle have to be stabled and fed during the winter, not being able to get a living in the fields on account of snow and ice.

"In the latter, the cattle feed in the fields all the winter, there being plenty of vegetation and no use of hay.

"On the Falkland Islands, (latitude 51–2° S.,) thousands of bullocks, sheep, and horses, are running wild over the country gathering a living all through the winter."

We should therefore have, on the eastern side of the South Atlantic, the counterpart of the warm isotherms which stretch up on the western side of the North.

The water in the equatorial cauldron of Guinea cannot escape North: the shore line will not permit it. It

must therefore overflow to the South, as that of St. Roque does to the North, carrying to Patagonia and the Falkland Islands, beyond 50° S., the winter climate of Charleston, South Carolina, on our side of the North Atlantic; or of the "Emerald Island," on the other.

From this source and from the Lagullas current, which receives its heat from the Indian Ocean, the South Atlantic is covered with a mantle of warmth which tempers to such a remarkable degree the climate of South America.

Because Western Europe had a mild climate and an ocean to the westward, and the eastern shores of North America a severe winter climate and an ocean to the eastward, a generalization has been deduced as to the climates of countries which have an ocean to the West, and of those which have an ocean to the East, which does not hold good.

This cauldron in the Gulf of Guinea and the Indian Ocean, which heats water for the South Atlantic, causes this rule, so far as the extra-tropical climate of South America is concerned, to have its exceptions.

All geographers have noticed, and philosophers have frequently remarked upon, the conformity as to the shore-line profile of equatorial America and equatorial Africa.

It is true, we cannot now tell the reason, though explanations, founded upon mere conjecture, have been offered, why there should be this sort of jutting in and jutting out of the shore line, as at Cape St. Roque and the Gulf of Guinea, on opposite sides of the Atlantic; but one of the purposes at least, which this peculiar configuration was intended to subserve is without doubt now revealed to us.

We see that by this configuration, two cisterns of hot water are formed in this ocean, one of which distributes heat and warmth to Western Europe; the other, at the opposite season, tempers the climate of Eastern Patagonia.

Phlegmatic must be the mind that is not impressed with ideas of grandeur and simplicity as it contemplates that exquisite design, those benign and beautiful arrangements, by which the climate of one hemisphere is made to depend upon the curve of that line against which the sea is made to dash its waves in the other. Impressed with the perfection of terrestrial adaptations, he who studies the economy of the great cosmical arrangements is reminded that not only is there design in giving shore lines their profile, the land and the water their proportions, and in placing the desert and the pool where they are; but the conviction is forced upon him also, that every hill and valley, with the grass upon its sides, have each its office to perform in the grand design.

Returning now to the study of Plate VII, and to the contemplation of the isotherms of 80°, for the different months, we are struck with the remarkable bending of all these lines towards the equator, on the eastern side of the Atlantic. This feature in them indicates, more surely than any direct observations upon the currents can do, the presence, along the African shores, of a large volume of cooler and running waters.

These are the waters which, heated up in the cauldron of St. Roque, in the Caribbean Sea, and Gulf of Mexico, have been made to run to the North, loaded with heat, to temper climates there. Having performed this office, they are obedient still to the "Mighty Voice" which the winds and the waves obey. They are returning by this channel along the African shore to be again replenished with warmth and to keep up the system of beneficent and wholesome circulation designed for the ocean.

The thermal charts abound with beautiful results and instructive facts, all of which are expressed by the charts themselves much more clearly and forcibly than my pen can utter them.

It is proposed to construct from the same journals, which have afforded the materials for these thermal charts of the Atlantic, which journals give the temperature of the air, also another set of thermal charts which shall relate to the temperature of the atmosphere over the ocean, though Professor Dove, by means of his valuable thermal charts of the atmosphere, has rendered this labor much less interesting than in the absence of his exquisite work it would have been ; for it has already been shown by this series of charts, in connection with his, that the remarkable bending of his isotherms as they enter the land along the western shores of Northern Europe and America, is owing in a great degree to the manner in which the aqueous curves of equal temperature approach those shores.

These charts will show very conclusively, and in a manner the most striking, that the mean temperature of the ocean at the surface is higher than that of the atmosphere.

The Track Charts.

The charts numbered series A, are the "Track Charts." Charts of this letter have been published for the North Atlantic, in eight large sheets, for the South Atlantic, in six; and for the west coast of America, in four. The remaining number of this series, both for the Indian and Pacific oceans, are in process of construction. They are all on a scale of 0.8 in. to a degree at the Equator.

The different sheets of this series show at a glance the frequented and unfrequented parts of the ocean; they inform the navigator as to the general character of the wind and weather, the force and direction of the currents encountered by those who have preceded him in the same part of the ocean, and at the same season of the year.

I have obtained* a list of arrivals at San Francisco from the Atlantic ports of the United States and Europe up to the middle of December, 1850. Taking the shortest passage for each month by American, English, French and Dutch vessels, we find that the American vessels which arrived there after the shortest passage in May, June, July, September, November and December, had each these charts on board. Of the vessels thus furnished, the shortest passage was by the Sea Witch in 97 days,† the average of the six being 114 days.

The shortest of the other six which did not have the charts was 119 days, and the average 128.

Mean average, taking the shortest passage only for each month:

For American vessels,		122 days.
" English	"	167½ "
" French	"	182¾ "
" Dutch	"	109½ "

*See San Francisco Herald, January 1, 1851. † The shortest passage since made, is by the "Flying Cloud," in 89 days 21 hours.

The average passage of *all* the American vessels that arrived during the year is 187½ days, *i. e.* 73½ days longer than the mean of the 6 shortest passages with the charts on board; 59½ longer than the six shortest without the charts—20 days longer than the average of the 8 shortest by English; 4¾ days longer than the 8 shortest by French, and 3 days shorter than the mean of the 7 shortest passages by Dutch vessels.

These charts are highly prized by practical navigators, and are eagerly sought after by them.

This series as far as published is the work of Lieutenant Whiting, Passed Midshipmen Wyman, Gibbon, Beaumont, Temple and Wooley; and of Professors Flye and Benedict, all of the Navy.

The Trade Wind Chart.

The charts of the series, marked letter B, are illustrative of the trade winds and the regions of calms and monsoons contiguous thereto. They are constructed according to a peculiar system of engraved squares.

This series, published only for the Atlantic, shows that the N. E. trade winds occupy a belt or zone extending in length from East to West across that ocean, having a variable breadth of from 17° to 35° of latitude. Its average mean breadth is about 23°; and in its extreme range it extends from 3° South to 35° North according to the season of the year.

This zone makes two vibrations in a year. It reaches its extreme northern declination usually in September. Then returning and following the Sun, it reaches its southern extreme in March and April. Being stationary for two or three months, between 3° and 4° North, it commences to return North, and in the months of August, September, and October, its other stationary period, it is seldom or never found to the South of the parallel of 9° N. The parallel of 9° N. may be taken as the mean limit of the equatorial border of the zone of N. E. Trades.

The S. E. trade winds occupy a similar zone in the South Atlantic, with a like vibratory motion. The mean equatorial limit of this zone instead of being near the parallel of 9° South, to correspond with the zone of the northern hemisphere, is in about 3° North.

It is a remarkable phenomenon, discovered in the course of these investigations, that the S. E. trade winds blow with more force than do their congeners of the northern hemisphere. They have force enough to push the latter with their belt back towards the North, intruding occasionally in the late summer, and in the early fall months, as far as the parallel of 9° North. Whereas, out of many thousands of records examined, it does not appear that the belt of N. E. trade winds is ever found to cross the parallel of 3° South.

The two zones of winds are characterized by a like difference of strength in the Pacific. The S. E. trade winds of the Atlantic ocean have force enough to push their equatorial limits over into the northern hemisphere, and to maintain them there during the greater part of the year. The reverse is never the case: the N. E. trades have not the force to crowd out the S. E. trades, and to maintain themselves for any month of the year in the southern hemisphere.

The prevailing direction of what are called the N. E. trade winds is, as nearly as the observations which mariners usually furnish enable me to determine, about E. N. E.

By resolving the forces which it is supposed are the principal forces that put those winds in motion, viz: calorific action of the Sun, and diurnal rotation of the earth, we are led to the conclusion, that the latter is much the greater of the two in its effects upon the trade winds of the northern hemisphere. But not to such an extent is it greater in its effects upon those of the southern. We have seen that those two opposing currents of wind are so unequally balanced that one recedes before the other, and that the current from the southern hemisphere is larger in volume; *i. e.*, it moves a greater zone or belt of air. The S. E. trade winds discharge themselves over the equator,—*i. e.*, across a great circle,—into the region of equatorial calms; while the N. E. trade winds discharge themselves into the same region over a parallel of latitude, and consequently over a small circle. If therefore we take what obtains in the Atlantic as the type of what obtains entirely around the earth, as it regards the trade winds, we shall see that the S. E. trade winds keep in motion more air than the N. E. do, by a quantity at least proportioned to the difference between the circumference of the earth at the equator, and the circumference of the earth at the parallel of latitude of 9° N. For if we suppose that those two perpetual currents of air extend the same distance from the surface of the earth, and move with the same velocity, a greater volume from the South would flow across the equator in a given time, than would flow from the North over the parallel of 9° in the same time; the ratio between the two quantities would be as rad. to the sec. of 9°. Besides this, the quantity of land lying within and to the North of the region of the N. E. trade winds is much greater than the quantity within and to the South of the region of the S. E. trade winds. In consequence of this, the mean level of the earth's surface within the region of the N. E. trade winds is, it may reasonably be supposed, somewhat above the mean level of that part which is within the region of the S. E. trade winds. And as the N. E. trade winds blow under the influence of a greater extent of land surface than the S. E. trades do, the former are more obstructed in their course than the latter, by the forests, the mountain ranges, unequally heated surfaces and other such like inequalities.

As already stated, the charts show that the momentum of the S. E. trade winds is sufficient to push the equatorial limits of their northern congeners back into the northern hemisphere, and to keep them at a mean, as far North as the 9th parallel of North latitude. Besides this fact, our investigations also indicate that while the N. E. trade winds, so called, make an angle in their general course of about 23° with the equator, (E. N. E.,) those of the S. E. make an angle of 30° or more with the equator (S. E. by E.) I speak of those in the Atlantic: thus indicating that the latter approach the equator more directly in their course than do the others, and that consequently, the effect of the diurnal rotation of the earth being the same for like parallels, North and South, the calorific influence of the Sun, exerts more power in giving motion to the southern than to the northern system of Atlantic trade winds.

That such is the case in nature is rendered still more probable from this consideration: all the great deserts are in the northern hemisphere, and the land surface is also much greater on our side of the equator

The action of the Sun upon these unequally absorbing and radiating surfaces in and behind, or to the northward of the N. E. trades probably tends to retard these winds, and to draw large volumes of the atmosphere that otherwise would be moved by them, back to supply the partial vacuums made by the heat of the Sun, as it pours down with active intensity, its rays upon the vast plains of burning sands and unequally heated land surfaces in our overheated hemisphere. The N. W. winds of the southern, are stronger than the S. W. winds of the northern hemisphere.

The charts shows that the influence of the land upon the normal directions of the wind at sea, is an immense influence. It is frequently traced for a thousand miles or more out upon the ocean.

For instance: the action of the Sun's rays upon the great deserts and arid plains of Africa, in the summer and autumnal months, is such as to be felt nearly across the Atlantic ocean between the equator and the parallel of 13° North. Between this parallel and the equator, the trade winds are turned back by the heated plains of Africa, and are caused to blow a regular southwardly monsoon for six months.

This monsoon is a discovery which has been fully and completely developed by the charts and the investigations connected with them. They (the monsoons) blow towards the coast of Africa from June to November, inclusive. They bring the rains which divide the season in these parts of the African coast. The region of the ocean embraced by the monsoons is cuniform in its shape, having its base resting upon Africa, and its apex streaching over 'till within 10° or 15° of the mouth of the Amazon.

Indeed, when we come to study the effects of South America and Africa, (as developed by these charts,) upon the winds at sea, we should be led to the conclusion—had the foot of civilized man never trod the interior of these two continents—that the climate of one is humid; that its valleys are for the most part covered with vegetation which protects its surface from the Sun's rays; while the plains of the other are arid and naked; and for the most part act like furnaces in drawing the winds from the sea to supply air for the ascending columns which rise from its overheated plains.

Pushing these facts and arguments still further, these beautiful and interesting researches seem already sufficient almost to justify the assertion, that were it not for the Great Desert of Zahara and other arid plains of Africa, the western shores of that continent within the trade wind region would be almost, if not altogether, as rainless and sterile as the desert itself.

These investigations, with their beautiful developments eagerly captivate the mind; giving wings to the imagination, they teach us to regard the sandy deserts, and arid plants, and the inland basins of the earth, as compensations in the great system of atmospherical circulation. Like counterpoises to the telescope, which the astronomer regards as incumbrances to his instrument, these wastes serve as make-weights, to give certainty and smoothness of motion;—facility, and accuracy to the workings of the machine.

The meteorological and physical researches with which the "Wind and Current Charts" are connected, relate only to the sea. Already the mariner has felt and acknowledged the importance of them. Commerce and navigation are reaping benefits from them of great moment. The merchants of Bombay and American navigators, with that regard for the practical and useful which adorns their character and makes them renowned,

have nobly stepped forward, and volunteered to co-operate with me in collecting facts for the further prosecution of the work. More than a thousand ships are now daily and hourly occupied in all parts of the ocean in making and recording, each a prescribed series of observations upon the winds and the currents, the rains, the calms, the storms, the thunder and the lightning;—the fogs, and clouds, and drift—the temperature of the air and water; and all other subjects and objects, facts and phenomena, which are of interest to navigation and to science. By a recent order of the Board of Admiralty also, every captain and master in the English navy are required to keep a "*Track Chart*" of the ship.

Enough of "Abstract Logs" has already been collected at this office to make upwards of two hundred large manuscript volumes, averaging each from two to three thousand days' observations, and the number is constantly increasing; indeed, the materials increase faster than I have force to discuss them.

When we travel out upon the ocean, and get beyond the influence of the land upon the winds, we find ourselves in a field particularly favorable for studying the general laws of atmospherical circulation.

Here, beyond the reach of the great equatorial and polar currents of the sea, there are no unduly heated surfaces, no mountain ranges, or other obstructions to the circulation of the atmosphere; nothing to disturb it in its natural courses. The sea, therefore, is the field for observing the operations of the general laws which govern its circulation. Observations on the land will enable us to to discover the exceptions. But from the sea we shall get the rule. Each valley, every mountain range and local district, may be said to have its own peculiar system of calms, winds, rains, and droughts. But not so the surface of the broad ocean.

In this connexion I beg leave to call the attention of meteorologists on shore to the importance of introducing a special column in their journals, to show what are the rainy winds at each station, and for each season of the year.

Upon every water-shed which is drained into the sea, the precipitation may be considered as greater than the evaporation for the whole extent of the shed so drained, by the amount of water which runs off into the sea. In this view, all rivers may be regarded as immense rain gauges; and the volume of water annually discharged by any one, as an expression of the quantity which is annually evaporated from the sea, carried back by the winds, and precipitated throughout the whole extent of the valley that is drained by it. Now, if we knew the rain winds from the dry, for each locality and season generally throughout such a basin, we should be enabled to determine, with some degree of probability at least, as to the part of the ocean from which such rains were evaporated. And thus, notwithstanding all the eddies caused by mountain chains, and other uneven surfaces, we might detect the general course of the atmospherical circulation over the land as well as the sea, and make the general courses of circulation in each valley as obvious to the mind of the philosopher as is the current of the Mississippi, or of any other great river, to his senses. That river so abounds with eddies, that it is difficult to tell by regarding small portions of its surface only, which way the water is flowing. But when we come to regard the drift wood and the whole river, we are left in no doubt as to the onward course of the main stream itself, with all its eddies and whirlpools.

These investigations as to the winds at sea indicate that the vapors which supply the sources of the Amazon with rain, are taken up from the Atlantic ocean by the N. E. and S. E. trade winds.

These investigations show that the trade wind regions of the ocean, beyond the immediate vicinity of the land, are, for the most part, rainless regions; and that the trade-wind zones may be described in a hyetographic sense as the evaporating regions.

They also show, or rather indicate as a general rule, that, leaving the polar limits of the two trade wind systems, and approaching the nearest pole, the precipitation is greater than the evaporation, until the point of maximum cold is reached.

They also indicate as a *general* rule, that the S. E. and N. E. trade winds which come from a lower and go to a higher temperature, are the evaporating winds, *i. e.*, they evaporate more than they precipitate; while those winds which come from a higher and go to a lower temperature, are the rain winds, *i. e.* they precipitate more than they evaporate. That such is the case, these charts indicate; reason teaches it to us; and philosophy tells us it is so.

The results of these charts, therefore, suggest the inquiry as to the sufficiency of the Atlantic, after supplying the sources of the Amazon and its tributaries with their waters, to supply also the sources of the Mississippi and the St. Lawrence, and of all the rivers, great and small, of North America and Europe.

A careful study of the rain winds, in connexion with the "Wind and Current Charts," will probably indicate to us the "springs in the ocean," which supply the vapors for the rains that are carried off by those great rivers.

"All the rivers run unto the sea: yet the sea is not full; unto the place from whence they come thither they return again."

Returning now to the trade winds of the Atlantic:—There is between the two systems, a region of calms, known as the equatorial calms. It has a mean average breadth of about six degrees of latitude. In this region, the air which is brought along to the equator by the N. E. and S. E. trades, ascends.

If we liken the belt of equatorial calms to an immense atmospherical trough, extending, as it does, entirely around the earth, and if we liken the N. E. and S. E. trade winds to two streams discharging themselves into it, we shall see that we have two currents perpetually running in at the bottom; and that therefore we must have as much air as the two currents bring in at the bottom, to flow out at the top. What flows out at the top is carried back north and south, by these upper currents, which are thus proved to exist and to flow counter to the trade winds.

Using still further this mode of illustration;—if we liken the calm belt of Cancer, and the calm belt of Capricorn, each to a great atmospherical trough extending around the earth also, we shall see that in this case the currents are running in at the top and out at the bottom: here the current from the equator meets in the upper regions, the current from the poles; the two descend; and the atmosphere which they thus pour into these belts run out at the bottom—on one side towards the equator, as the perpetual trade winds;—on the other, towards the poles as the prevailing winds of the the regions between these belts and the polar circles.

The belt of equatorial calms is a belt of constant precipitation. Capt. Wilkes, of the Exploring Expedition, when he crossed it in 1838, found it to extend from 4° N. to 12° N. He was ten day in crossing it,

and during those ten days rain fell to the depth of 6.15 inches, or at the rate of 18 feet and upwards during the year.

This belt of calms vibrates up and down the ocean as the belts of the trade winds do. In the summer months it is found between the parallels of 8° and 14° of North latitude, and in the spring between 5° S. and 4° N.

By this chart the navigator can tell what places within the range of this zone, have, during the year, two rainy seasons, what one, and what are the rainy months for each locality.

Were the N. E. and the S. E. trades with the belt of equatorial calms of different colors and visible to an astronomer in one of the planets, he might, by the motion of these belts or girdles alone, tell the seasons with us.

He would see them at one season going North, then appearing stationary, and then commencing their return to the South. But though he would observe that they follow the Sun in his annual course, he would remark that they do not change their latitude, as much as the Sun does his declination; he would therefore discover that their extremes of declination are not so far asunder as the tropics of Cancer and Capricorn, though in certain seasons the changes from day to day are very great. He would observe that these zones of winds and calms have their tropics or stationary nodes, about which they linger near three months at a time; and that they pass from one of their tropics to the other in a little less than another three months. Thus he would observe the whole system of belts to go North from the latter part of May till some time in August. Then they would stop and remain stationary till winter, in December; when again they would commence to move rapidly over the ocean, and down towards the South, until the last of February or the first of March; then again they would become stationary and remain about this, their southern tropic, till May again.

The zone of the S. E. trade winds would present to him its northern edge inclined somewhat to the equator; commencing near the coast of Africa and tracing the usual outlines of this edge over towards South America, he would discover that it approached the equator at an angle of about 18°; and our supposed astronomer would announce that the equatorial edge of the zone of S. E. trades in the Atlantic is inclined towards the equator at an angle of 15°—that it lies W. 15° N., and E. 15° S.

Turning his attention now to the belt of N. E. trade winds, he would observe the equatorial edge of this zone to be somewhat, though not altogether, symmetrical with the equatorial edge of the S. E. trade wind zone of the other hemisphere. On the African side it is farthest from the equator, which it approaches at an angle of about 10° (W. by S.) until it reaches the meridian of abut 40° West. Here it is deflected to the North and trends off in the direction of W. N. W. Here we begin to experience the effect of the North American continent upon the trade winds at sea. The rarefication caused by the lands of northern Texas and the arid plains in that quarter, is sufficient in summer to convert the N. E. trades of the Gulf of Mexico into a prevailing wind from the southward and eastward.

In the Pacific and within a certain distance from the land, the N. E. trade winds are, by the same influences, as these researches into the winds and currents of the sea have revealed, converted into a southerly monsoon.

By tracing on a chart the equatorial limits of the N. E. and S. E. trade winds, as herein described, it will be perceived that there is left between the two systems a wedge-shaped band having its broadest part on the African side of the Atlantic. The region of the ocean which the Planetary Astronomer would observe this band or belt to cover, is the region which is occupied by the equatorial calms and the African monsoons that fall between the systems of N. E. and S. E. trade winds. And were the belt which represents these calms different from the rest as to color, the imaginary astronomer would see it as somewhat of an irregular curve, not having the northern and southern edges concentric. The concave side of this curved belt is turned to the E. of N., and has its centre near the shores of Greenland.

As before remarked, the newly discovered monsoons of the North Atlantic ocean also come within the belt of equatorial calms. They give the peculiar wedge-shaped form to the regions between the two systems of trade winds.

Having completed the physical examination of the equatorial calms and winds, if the supposed observer from some distant sphere should now turn his telescope towards the poles of our earth, he would observe a zone of calms bordering the N. E. trade winds on the North, and another bordering the S. E. trade winds on the South. These calm zones also would be observed to vibrate up and down with the trade wind zones—partaking of their motions and following the declination of the sun.

On the polar side of each of these two calm zones there would be a broad band extending up into the polar regions, the prevailing winds within which are the opposites of the trade winds, viz: S. W. in the northern and N. W. in the southern hemisphere.

The equatorial edge of these calm belts is near the tropics, and their average breadth is 10° or 12°. On one side of these belts the winds blow perpetually towards the equator; on the other, their prevailing direction is towards the poles.

These belts therefore may also be considered as nodes in the general system of atmospherical circulation.

The atmosphere which the N. E. and S. E. trade winds keep in perpetual motion towards the equator has for its node the equatorial calms. Here it ascends, boils over, divides, and flows off in the upper regions of the atmosphere, one part going to the northern, the other to the southern hemisphere, to complete the "circuit of the winds," and to supply the sources of the trade winds with air.

Arrived near the Tropic of Cancer, the northern current meets, in the upper regions of the atmosphere, the return current which the prevailing winds of the north temperate zone have carried as a surface current to the hyperborean regions of the North. These two currents produce another node or calm region, in which the atmosphere descends, and from which it issues both to the North and South, assuming, on one side, the character of N. E. trades; on the other the character of the S. W. passage winds.

This node has its fellow in the southern hemisphere, where there is a like meeting of upper currents; only from one side of the zone of the calms of Capricorn, the wind issues as the S. E. trades; from the other as the N. W. passage winds of that part of the southern hemisphere, which is extra-tropical. See Plate II, in which the two outer lines marked A, B, and so on, are drawn to represent the vertical, and the arrows on the shaded ground the horizontal, motion of the atmosphere.

Along the polar borders of these two calm belts, we have another region of precipitation, though generally the rains here are not so constant as they are in the equatorial calms. The precipitation near the tropical calms is nevertheless sufficient to mark the seasons; for whenever these calm zones, as they go from North to South with the sun, leave a given parallel, the rainy season of that parallel, if it be in winter, is said to commence. Hence we may explain the rainy season in Chile at the South, and in California at the North.

This letter of the series of the charts will enable any one who consults it, to tell to what places the tropical calms bring rain, and in what months the rainy season commences and ends for any parallel.

To complete the physical examination of the earth's atmosphere, which we have supposed an astronomer in one of the planets to have undertaken according to the facts developed by the wind and current charts, it remains for him to turn his telescope upon the icy regions of the poles. (For, that *we* should complete the examination in this respect, it would be necessary to obtain the log books of ships in the anti-commercial regions of the ocean, which we cannot do. As the sea is most open near the South pole, the principle of the general law of atmospherical circulation would be better developed probably by observations in the Antarctic, than in the Arctic regions.)

For the want of such observations, but with the light which these charts throw on the subject for our guide, let us pursue the S. W. passage winds of the northern hemisphere into the Arctic regions, and see theoretically, with the imaginary telescope, how they get there; and being there, what becomes of them.

From the parallel of 40° up towards the North pole, the prevailing winds in the northern hemisphere as already remarked, are the S. W. passage winds, or as they are more generally called by mariners the "Westerly" winds; these, in the Atlantic, prevail over the "Easterly" winds in the ratio of about two to one.

Now, if we suppose, and such is probably the case, these "Westerly" winds to convey in two days a greater volume of atmosphere towards the Arctic circle than those "Easterly" winds can bring back in one, we establish the necessity for an upper current by which this difference may be returned to the tropical calms of our hemisphere. Therefore, there must be some place in the polar regions at which these S. W. winds cease to go North, and from which they commence their return to the South, and this locality must be in a region peculiarly liable to calms. It is another atmospherical node in which the motion of the air is upward, with a decrease of barometric pressure. It is marked P, Plate II.

If we now return to the calm belt of the northern tropic, and trace theoretically a portion of air that in is circuit shall fairly represent the average course of these S. W. passage winds, we shall see that it approaches the pole in a loxodromic curve; that as it approaches the pole it acquires from the spiral convolutions of this curve which represents its path, a whirling motion, in a direction *contrary* to that of the hands of a clock, and that the portion of atmosphere whose path we are following, would gradually contract its gyrations, until it would finally ascend, turning against the hands of a watch, as it whirls around.

After reaching the upper regions of the atmosphere, through this whirl, its course would be to the southward; or rather, owing to the effect of the axial rotation of the earth, its course would be from the northward and eastward, until it should meet also in the upper regions a like portion from the ascending node formed in

the calms near the equator. This place of meeting in the upper regions of the atmosphere, as already remarked, takes place in the zone of the calms of Cancer. Here the two currents, the one from the poles, the other from the equator, balance each other, produce a calm, or the descending node for the northern hemisphere, with an increase of barometric pressure.

In the southern hemisphere a like process is going on; only there, the N. W. passage wind would, as it arrives near the Antarctic calms, acquire a motion with the Sun, or in the direction of the hands of a watch.

That such is the case, the investigations that are carried on here do not prove, but they, and a process of reasoning guided by analogy, derived from what they do show, suggest that such is *probably* the case.

The general course of the circulation of the atmosphere, as partly established and partly suggested by these researches and other sources of information is: an upper current from the poles, as far as the tropical calms, towards the equator; thence a descent and a surface current (N. E. and S. E. trades) to the equatorial calms. Here an ascent takes place, through which air is supplied for an upper current each way towards the poles, as far as the zone of tropical calms. Here there is a descent; and a continuation towards the polar regions as a surface current, (S. W. passage winds in the northern, N. W. in the southern hemisphere,) until it approaches, in part, the calms of the Arctic and Antarctic regions. Here it commences to whirl about in the manner already stated, forming the supposed polar calms, in which it ascends, and so commences its return towards the equator by reversing the circuit just described. Vide Plate II.

The following is a part of the history connected with these investigations as to the circuit of the winds: *Extract from a letter to the Prussian Minister, Baron Von Gerolt, dated, National Observatory, June* 20, 1850.

"Speaking in advance somewhat of my publication, but leaning, nevertheless, upon the indications already given by the investigations which are in progress at this office with regard to the winds and currents of the sea, and the phenomena connected therewith, I may remark that certain conclusions have been forced upon me, with such veri-similitude, that it only remains for Professor Ehrenberg, with his microscope, to write the final Q. E. D. to them.

For instance, my investigations of the winds at sea, so far as they bear upon the subject, seem to indicate that the rivers and fresh water of the northern, temperate and frigid zones, are, for the most part, evaporated from the South torrid; or, more properly speaking, that they are taken up from the sea by the S. E. trade winds. Such at least is the indication; and certain facts so tend in their bearings, as to convert this indication into a conclusion that does not appear altogether forced.

As a general rule, most of the land is in the northern, and most of the water in the southern hemisphere. But notwithstanding the absence of evaporating surface in the northern hemisphere, most of the precipitation takes place there, if we regard the waters that are discharged into the ocean by the rivers as an expression of the excess of the precipitation over the evaporation that takes place in the basins drained by these rivers. The basin of the Amazon is in both hemispheres; it is, therefore, common, and should not be counted as peculiar to either. The Rio de la Plata is the only great river then in the southern hemisphere; whereas, in the northern, are all the rivers, great and small, which give drainage to Europe, Asia, and America.

The question then comes up; Does the Atlantic afford evaporating surface sufficient to supply all the rivers of Europe and America with rain water? and, if so, by what winds do the vapors, that make these rains, travel both East and West from the same place?

Very little of America and no part of Europe is within the region of the N. E. trade winds; and the trades, because they come from a colder and go to a warmer climate, are eminently evaporating winds. But how is it to the North of the N. E. trade winds, where, on the surface of the earth, the S. W. are the prevailing winds? Here, as a general remark, the winds are going from a warmer to a colder climate, and therefore ought, it would seem, to precipitate more than they evaporate. Thus, take the isotherm of 60° Fahr. in the Atlantic, as an example: the mean dew point, we will suppose along this line, is between 50° and 60°, or at any other degree below 60°—suppose 55°—that we may choose for the illustration.

Now let us proceed still further North in this ocean until we reach the isotherm of 30°: on this line the mean dew point must be below 30°, how much we cannot say, nor is it material for the illustration that we should say. It is certainly below the mean dew point of 60°. Now what becomes of the vapor that has caused the mean dew point of the isotherm of 60° to change to that which belongs to the isotherm of 30°? It has been precipitated, and the capacity of the air to retain moisture has been lessened proportionably. In thus viewing the case, the question arises: Whence are the vapors taken which supply with rain the sources of the rivers of the North temperate and frigid zones?

You will understand me as speaking in general terms, without regard to any of the exceptions caused by anomalies, such as the Gulf Stream and the like.

Where the N. E. and S. E. trade winds meet, they produce what is known as the belt of equatorial calms. This is one of the valves in the great atmospherical machine, through which the air that is brought from the North and the South by these trade winds, rises and escapes into the upper regions of the atmosphere, and thence returns to supply the sources of the trades with fresh air to make more winds of.

Now the question is: Does the air which is brought to this valve by the S. E. trades continue on towards the North in the upper regions of the atmosphere, while that which comes down as the N. E. trades continues on towards the South in like manner? or does the air which the S. E. trades bring to this calm place, rise up and return to the South? or does the air of the two trades intermingle here, and go, a part of it indiscriminately, either to the North or to the South as chance may determine?

I am inclined to favor an affirmative reply to the first of these interrogatories; and for these reasons, in addition to those already alluded to:

1st. Winter, late fall, and early spring, are the seasons of our greatest precipitation; and this is the time when the sun is pumping up the vapor with the greatest energy from the southern, and with the least from the northern oceans—and so too when the sun is pumping up vapor from the northern hemisphere with all his energies, precipitation is most active in the southern.

2d. The belt or band over which the S. E. trades prevail is much broader than that over which the N. E. trades prevail; consequently, supposing the velocity of each trade wind to be the same, or nearly the same, the

S. E. trade takes up more moisture because it sweeps over a broader belt of ocean; and, sweeping over a broader belt, it remains longer in contact with the evaporating surface; and consequently it may be supposed, it brings more moisture to the belt of equatorial calms whence the ascent takes place.

A large portion of this moisture is deposited in the equatorial calms, which we know is a region of constant precipitation.* But where is the rest precipitated—in the northern or southern hemisphere? In the former, I suppose; because the rivers and the rain-gauge, as far as it has been observed, tell us that the total amount of precipitation in the northern, is greater than that in the southern hemisphere; indeed, it is not necessary to consult the rain-gauge to learn this; the rivers themselves are sufficient rain-gauges for this purpose; for we have only to consider the volume of water annually discharged into the ocean by northern rivers, to see in it an expression for an amount by which the total precipitation is in excess of the total evaporation which takes place in the whole extent of valleys drained by such rivers. Search the southern hemisphere for a like quantity, and the search will be in vain.

Seeing, moreover, that the southern hemisphere has more water and less land than the northern; that it has less rain and fewer rivers, it seems as though, in likening the atmosphere to an immense machine, we might call the southern seas the boiler, and the northern continent, the condenser for the mighty engine.

There is, perhaps, another point upon which an argument, not altogether without plausibility, may be turned in favor of this hypothesis.

The grounds for this argument are drawn from probability, and the argument itself rests on the degree of belief and faith we have in the perfection of terrestrial adaptations.

To state the argument in this point of view, we must consider the atmosphere, not only as a great condensing machine, but as an immense sewer, in which vast quantities of corrupt animal and vegetable matter are continually being cast for re-elaboration, purification, re-arrangement, and re-adaptation to the purposes of the animal and vegetable kingdoms.

Notwithstanding the quantity of matter that the plants and animals of the earth are continually taking from the atmosphere on the one hand, and are as continually casting into it on the other, so admirably arranged is it, and so perfect its system of circulation, now across the seas, now through forests, and again over deserts, burning sands, and frozen heights, that its proportions are never destroyed.

In this system of purification and preservation, we know that vegetation in active growth has much to do.

Now, then, if we consider that the N. E. trade winds, when they arrive at the equator, ascend, return to the North in the upper regions until they reach the parallel of 30° or 40° North, where they descend to the surface, and are known as what the Germans style the S. W. passage winds; if, I say, this be the course of atmospherical circulation, we shall see that the air in our winter time, when vegetation is asleep with us, would probably not be exposed to the process necessary for its purification; and finally, if such were the system of

circulation, the atmosphere of the northern hemisphere would, in the process of ages, probably become different from that of the southern hemisphere.*

We have no reason to believe in the existence of any such change in the components of the atmosphere; and I had almost said, *therefore*, in any such partial system of circulation.

On the other hand: if we maintain that the S. E. trade winds flow North after ascending into the upper regions of the atmosphere through the equatorial calms, and that it is those winds, and not the N. E. trades that in their circuit blow our S. W. passage winds; if, I say, we maintain this, we shall see the beautiful adaptation for exposing them to the proper and wholesome vegetable agencies; our winter is the southern summer: then the S. E. trades blow through the southern forests which are then in their stage of activity.

Arrived at the equator—properly prepared for the use of the inhabitants of the North temperate and frigid zones—they ascend into the clouds; and, after reaching the parallel of 30° N., they descend, and are then felt as the vigorous, wholesome, and healthful S. W. passage winds of the northern winter; continuing on towards the North frigid zone, they perform their office for the inhabitants of those inhospitable climates, and approaching the polar regions in spirals, they whirl continually around or about the pole in a direction contrary to that of the hands of the watch.

Returning thence in the upper regions towards the South, as unfit for further use, they are next felt on the surface within or near the tropics, where vegetation is again in activity, to fit them for the inhabitants of that region; reaching the equatorial calms, they ascend, and next appear on the surface in the South temperate zone as the N. W. passage winds.

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*The extra-tropical regions of the North have much more land, and therefore it may be supposed many more organs than the South to breathe, consume, and vitiate the atmosphere; consequently in any given time, as in a northern winter, the demands upon the atmosphere are very unequal on opposite sides of the equator. On one side, the animal kingdom is exacting from it in excess; on the other—the southern summer—the vegetable.

Speaking in general terms, it may be said that man with his retinue of domestic animals, counts in the South but as one in a thousand to his hosts at the North. These myriads of warm-blooded animals in the northern hemisphere, with the fires kindled by man in our winter, leave us to infer that more air is required for animal consumption and combustion on one side of the equator than on the other, especially in the northern winter.

The air thus used, loses the proportions of gaseous combinations required to make it wholesome; whence, therefore, is it purified? Not by the vegetation of the extra-tropical North, certainly, for its vegetation is then asleep.

But if we make this air return to the South by the route suggested, it will pass through the N. E. trade-wind regions, and be partly replenished by the perpetually active vegetation there. Then rising in the equatorial calms, and overleaping, in the upper regions, the S. E. trades, it descends to the surface in the extra-tropical South, where it is summer, and where the forces of vegetation are in their most active operation.

Returning in the upper regions towards the North, still more refreshed from this part of its circuit, it first strikes the surface again as the S. E trades, where vegetation is again perpetually active. Being now completely purified, it rises up again in the equatorial calms, overleaps in the upper regions, the N. E. trades, and descends in the extra-tropical North, fresh with supplies in wholesome proportions for breathing lungs and winter fires.

And thus, though we cannot tell the reason why this earth was provided with zones of perpetual summer, alternate winter and opposite seasons, we may nevertheless see through the atmosphere one of the purposes for which this arrangement of seasons, combination of climates, and proportion of vegetable surface was intended to subserve.

In this view we see room for the harmony of nature. We have not a single physical fact going to prove that such is *not* the course of the circulation of the atmosphere about the surface of the earth; but we have many facts and circumstances which, though they do not *prove*, yet they suggest, that such is the course.

Thus, using a figure of speech, we may liken these evergreen places through which the winds go and return, to the lungs of the *earth*, with their three lobes: one in each of the trade wind regions, and one now at the North, now at the South, changing from one side *to the* other, as the summer comes and goes.—M. F. M.

Continuing on towards the South Pole, and approaching it in spirals, they whirl about, but in a direction with the hands of a watch, and opposite to that which they took about the North Pole.

Ascending into the upper regions of the atmosphere, they are next felt on the surface as S. E. trade winds; reaching the equator, ascending, and coming over into the northern hemisphere, they are again felt to the North of the N. E. trades as the S. W. passage winds.

Let us suppose that this part of the circuit from the Antarctic regions be made in our summer, and of course in the southern winter, when the vegetation here is not so active in its demands upon this atmosphere in motion, as it was in the other part of the supposed circuit.

But then this same atmosphere that has been but partially purified for northern use in the southern forests and fields, reaches us in our summer, when vegetation is in full activity, and when, therefore, all disproportions are properly compensated.

I have faith in the "great first thought." I believe that the animal and vegetable kingdoms are in exact counterpoise; that through the dominions of nature all things are in exact and rigid proportions; that there is not a green leaf too much on one side, nor an insect too many on the other. And because of this belief, I find plausibility and satisfaction in supposing that the general system of atmospherical circulation is as I have been endeavoring to represent it.

In this belief I am strengthened by my reading of a text of Scripture, (and the Bible no more than Nature can be wrong, for the Author of both is One,) which seems to apply to such a system of circulation:

"The wind goeth towards the South, it turneth about unto the North, it whirleth about continually; and the wind returneth again according to his circuits."

Compare this with what I have already said, which my investigations taught me was the probable course of atmospherical circulation before I remembered me of what Solomon had said, and I think you will find with me, not proof, but grounds to suppose that such may be the system of atmospherical circulation.

The Whale Chart.

In 1847, materials sufficient having been collected from the log books of whalers for an investigation into the habits and places of resort of the whale, Lt. Wm. L. Herndon commenced the construction of this "whale chart" for the whole ocean, excepting the North Atlantic.

The object of this chart is to show at a glance, where this fish have been most hunted;—when, in what years, and in what months it has been most frequently found—whether in shoals, as stragglers;—and whether sperm or right. The sheets are numbered letter F of the series.

Lieut. Herndon was interrupted in these highly interesting investigations, by orders for sea service. He had proceeded far enough however with the charts to develop some of the first fruits, which it might be expected, are concealed in a field so abundant with treasures as this may be well supposed to be. But these orders deprived me of the assistance of a most valuable officer, and greatly delayed the work.

The plan of conducting these investigations is by spaces of 5° square, and the observations are so entered as to show at a glance the number of days for each month spent in each square; the number of days in which whales—and whether they are sperm or right—have been seen; also, the years in which whales of either kind were seen, and the years in which they were not seen, in any given square.

As observation after observation in such an immense field was recorded day after day, with the most untiring industry, and as the oft repeated process finally began to express a meaning, I was surprised to find the lines for entering the right whale were blanks, through certain districts of the ocean, from one side of the chart to the other. Finally it was discovered that the torrid zone is to this animal forbidden ground, and that it is physically as impossible for him to cross the equator as it would be to cross a sea of flame. In short, these researches shew that there is a belt from two to three thousand miles in breadth, and reaching from one side of the ocean to the other, in which the right whales are never found.

Hence the discovery that the fish called the right whale in the Northern hemisphere is not the fish which goes by this name in the Southern: that the right whale of Behring's Straits and the whales of Baffin's Bay are probably the same animal; and if so, the conclusion is almost inevitable that there is at times at least, an open water communication through the polar regions between the Atlantic and Pacific oceans; for this animal not being able to endure the warm waters of the equator, could not pass from one ocean to the other unless by way of the Arctic regions.

The investigations connected with these animals have also pointed out to us the great currents of warm water which keep up the ocean circulation of the Pacific—it might be said of the globe; for as we study their habits, these dumb creatures teach us by their instincts that there are continuous currents in the sea between places the most remote.

With the aid of what the whales have taught us, in connection with what we have learned from other sources, we can now *almost* prove the existence of a continuous current of water from the borders of the Red sea into the English Channel. The current, which has its genesis partly in the Red sea, and partly in the Indian ocean and its contiguous bays, is bifurcated off the African coast by a cold current from the South. And were it possible to throw into the Red sea two bottles properly marked and labelled, which would not be drifted out of the current, but which would separate at the forks of the stream, these two bottles would, or might pass, one around Cape Horn, and the other around the Cape of Good Hope; and meeting again in the tropical regions of the Atlantic ocean, it would, theoretically, be possible for them to drift into the Caribbean sea;—thence through the Gulf of Mexico;—and by the Gulf Stream out again into the Atlantic ocean; and by its waters they might be cast up together on the shores of the British Islands, as the drift of the Gulf Stream is often cast.

There is an under current from the Red sea, and the course of the supposed bottles would be with that under current out into the Gulf of Aden; thence, rising to the surface of the Arabian sea—an immense cauldron without any escape, as from our Gulf of Mexico, for its heated waters to the North,—they would be drifted to the south in the currents from this sea: arrived near the Cape of Good Hope, this current is bifurcated by *a cold one* from the South going to replace the waters which it has conveyed from the North.

Here the bottles would separate, one following the Lagullas current around the Cape of Good Hope into the Atlantic.

The other taking the other branch of the stream, would be drifted to the southward of New Holland, and be carried into the Antarctic regions near Victoria land. Here the current being cooled down and deflected, it would commence its flow towards the North as the ice-bearing current which flows into the Atlantic around Cape Horn,—the icebergs of which I have encountered in latitude 37° South. Bottles that have been thrown overboard off Cape Horn, have been picked up on the shores of Ireland.

However, without pursuing just now this system of currents pointed out by the bottles and the whales, and suggested by the dynamical forces imparted by the salts of the sea to its currents, I propose at another time a still further investigation and account of these beautiful and interesting facts which the Whale Charts are developing.

After Lieut. Herndon was called away, the investigations for these charts were continued by Lieut. Leigh for a short time. His duties were soon changed, and I remained without force to resume the work, till late in 1850, when Lieut. Fleming reported for duty. He was set to work on the "Whale Charts," but before he had made any progress with them worth the name, he was detached and ordered on other duty. Passed Midshipman Jackson then took them in hand, and completed them.

They show in what part of the ocean the whales "use" in each month, and the knowledge cannot fail to prove of great importance to the whaling interests of the country,—an interest which keeps in continual occupation a fleet of 600 sail, manned by 15,000 American seamen—and which fishes up annually from the depths of the ocean, property, the real value of which far exceeds that of the gold mines of California.

Plate IX exhibits an extract from the Whale Chart.

The object of these charts is to show where the whalemen have hunted, and where they have found their game; consequently, this chart enables us to designate those parts of the ocean where the whales "use," and those parts where they never go—and to tell where in each month this animal is most likely to be found.

The three horizontal lines, Plate IX, marked D. R. S., in the middle column, repeated from parallel to parallel, stand: D. for days; R, and S. for the number of days, each, on which whales, Right or Sperm, have been seen. The days of search are expressed in figures; the days on which whales are seen are expressed by the system of "fives and tallies," as already explained with regard to the winds.

It will be observed, that from 60° North, to 60° South, between the meridians of 125° and 130° W., right whales, except in one instance, have never been reported by any of the vessels whose Logs have been examined. That sperm whales except a straggler or two, have never been seen between these meridians, and below 5° S.; between which parallel and the equator they are most abundant. That they are seen between 35° and 50° N; between the equator and 10° N.; but not between 10° and 35° N.; and the inference is drawn from the fact of their appearing so frequently between the parallels of 35° and 50° N., that warm water is found there.

The investigations for this chart are so conducted as to show the years in which the whales have been searched for and seen in the various districts of the ocean. These results are the embodied experience of several hundred whalemen as to the best fishing grounds.

Besides the practical advantages which it is conjectured will inure to the whaling interest from these investigations, much information of a highly interesting character will probably be elicited by them for the naturalist and geologist.

Scenes and information how interesting so ever to the world at large they may be, yet by often recurring, lose their novelty to classes; they become familiar, cease to strike, and are at best apt to be thought not worth speaking or writing about. This is particularly the case with regard to the whalemen and their calling.

With the view of reminding them how little is known by the world generally, with regard to the habits of the whale, it may be remarked that the information conveyed in the communications from them, which are now published and which information has been obtained from them by accident or chance as it were, will be read with much interest by men of science.

The gentlemen who were kind enough to furnish this information, had, I am sure, no idea of its publication; but I hope they will excuse the liberty for the sake of the motive.

These papers will, it is hoped, be the means of calling forth much additional information of a kindred nature.

Letters from Whalemen.

Capt. Daniel McKenzie to Lieut. Maury—dated, New Bedford, June 8th, 1849.

"Herewith I forward some additional knowledge of the *sperm whale*, their *history*, *habits*, *food*, *age*, &c.; also the laws that govern their migratory movements, with such other thoughts as may occur to memory as I write.

The sperm whale, though found in every sea and clime, yet their great nursery is in the great Pacific; their haunts are found there from coast to coast; their limits that of the ocean itself. The males are more frequently found in high latitudes, the other sex in milder climates; a tropical region seems to suit them best: they seek bays in islands and coral beds and reefs in vast shoals to bring forth their young. The period of gestation I do not know. Perhaps no animal found in the sea are more timid and easier frightened; they alway group by themselves, and seem to shun the society of other tribes of the ocean.

Their powers of vision are exceedingly limited, they cannot see directly ahead of them; hence they often when alarmed, run foul of each other, and foul of other objects. I have seen them run against a whale boat, and the concussion so alarm them as to create the most convulsive phrenzy; and I think they are as unconscious of the approach of the harpooner from that direction as when he follows after them. Their exquisite sense of hearing, however, is most extraordinary; not unfrequently in large shoals covering miles of space, the instant one is attacked, the whole school for miles around spring, shoot out their heads above water, and listen for a moment, and if the attack is made on a female (or cow) they will all rush with great speed to their wounded companion, as if to extend their sympathy, if nothing more, unconscious of their own danger. The bold whaler avails himself of their approach, lays off a short distance from his bleeding victim, and takes them as they come; and if he is clever at the deadly game, he will mortally wound several, ere they discover the tragic act

he is playing; but if the first one attacked happens to be a male, nine times in ten the shoal will run off with such rapidity as soon to be out of sight. The cows are found in shoals from 25 to a hundred in number, not only at their usual haunts while feeding, but also in their migratory movements in search of food, accompanied generally by one large bull, who seems to reign over all as king, whose head is always found covered with scars and wounds, the result, as we always thought, of battles fought with other bulls in defending his gallantry for the other sex. The principle article of food (and indeed the only one as far as I know) is squid; the smaller kind they eat is found near the surface, and is from two to three feet in length; the larger kind, which probably have their haunts deep in the sea, must be of immense size—the flesh soft and of gelatinous substance. I have seen very large junks floating on the surface entirely shapeless. The cows on an average will yield fifteen barrels of oil; the males, (or bulls, as whalers call them,) are much larger, will yield from fifty to one hundred barrels of oil. At this stage, he is a noble animal, moving through the water so graceful, and with such majesty, and with such astounding velocity; and that too, without apparent muscular action, is sublime; and when attacked, such perfect command over his locomotion as to entirely change his position as quick as thought. I have seen them lay motionless fifty feet off, and in an instant swing their huge flukes under us, and at one blow send the boats in splinters, men and all, ten feet in the air.

Large whales are seldom seen in groups; frequently four or five are found within as many miles of each other, but more frequently alone. In their several stages of growth, the males will be found in shoals all very nearly of a size; some shoals will yield 20, some 30, some 40, and sometimes 50 barrels, each whale. The males when very young, frequently accompany the other sex, as boys and girls go to school together, and as they approach a more mature stage, they separate.

I have never been able to approach any satisfactory result in relation to the time a sperm whale lives; the general opinion is that they live forty or fifty years. I once extracted the barbed end or head of a harpoon from the back of a large whale, enclosed nicely in the oily blubber, and the wound entirely healed where it had been lodged fourteen years. This was satisfactorily proved after we got home, by the initials of the blacksmith who made it on one side, and the initials of the captain on the other. I remember the whale yielded about fifty barrels of oil; there was nothing in the appearance of the whale indicating old age. I have often noticed their teeth rotten and decayed down to the jaw, and others worn down level with the gum by mastication, and covered with wrinkles and furrows, having a way-worn appearance, evident marks of slow but progressive deterioration.

The ship Balena, of this port, Capt. E. Gardner, while at anchor at Karakakua bay, in Owhyhee, took a large sperm whale off the bay, that yielded them one hundred and two barrels of oil, whose teeth were worn down level with the gum, evidently by masticating his soft food. This noble animal had no other appearances of extreme age, but seemed to have enjoyed full vigor of health and life; who then can tell the length of life they reach, ere it terminates by the ordinary process of nature! may it not as probably reach a hundred years, as close at forty?

I have said that the cows seek bays and still water to bring forth their young; they never visit shallow

water; they go to such bays only where the water is blue and deep, and under the lee of islands and reefs—the bays at the great island of Albemarle, of the Gallapagos group, is often visited by large shoals of cows for that purpose—the water in those bays is of great depth, and as blue as the Gulf Stream.

I have said that squid is the only article of their food. I am aware that others think differently; that they do eat other fish. I can only judge from what I have seen. After a sperm whale is mortally wounded, and is in his last struggle, he not unfrequently throws up the contents of his stomach; which in the hundreds of instances I have seen, I have never discovered any thing but parts of squid. In cutting them up also, I have often opened the stomach, and never noticed any thing but squid; hence I infer, that squid is their only food.

Their great object of migrating from place to place is no doubt in search of food; they are often seen in large bodies moving quickly, all in one direction; by getting their course as they pass, and following on after them, in a few days, again meet them brought to, feeding and laying quite still, and headed in different directions. In this case, the whaler often succeeds in getting a large share of oil before they are so harrassed and cut up as to compel them to abandon the ground.

I have often thought that currents had much to do with the movements of sperm whales: and as they are most always found heading it where it is strong, I have thought it was to meet the bait brought down with the current, particularly near the equator in the Pacific, where a current is always found setting to the westward, which grows stronger as you proceed westward, and the whales generally found stemming it, headed to the eastward.

I have spoken of the timidity of sperm whales. I have known instances near the land, where sperm whales were laying entirely still, a seal to spring in among them, and start them to running with great violence. I have also known them started and set running by the approach of porpoises.

It is remarked by many experienced sperm whalers—though I never noticed it very particularly myself, except in large whales—that after rising to the surface from their deep submarine explorations, they would breathe or spout as many times as they will yield barrels of oil. How this rule works with small whales, I never noticed; but I do know that those we rank as large whales, yield from fifty to one hundred barrels,—do when undisturbed spout from fifty to one hundred times; as a general rule, they spout from sixty to seventy times, and yield when taken, from sixty to seventy barrels of oil.

Large Sperm whales remain submerged in search of food, from an hour to an hour and a half, which I presume is as long as they can hold their breath, for when they rise (unless disturbed or making a passage) lay quite still as if breathing was the ostensible object.

That sperm whales do perambulate the whole ocean, I have no doubt. Instances are known of their being harpooned on the Japan coast, and disengaging themselves from the boat, have afterwards been taken on the coast of Chili; this was known by the ship's mark on the harpoon. One instance is known where a sperm whale was thus struck on the coast of Peru, and subsequently, taken off the coast of the United States.

I have often met sperm whales off the Cape of Good Hope, and off Cape Horn, making their passage from sea to sea.

I notice our ships have discovered a new region, new haunts for right whales. They enter the Yellow sea early in the season, and as it advances, they proceed North, through the Straits of Corea into the sea of Japan; thence North up the Gulf of Tartary; thence through the Perouse Strait into the sea of Seghalien; thence up the Ochotsk, following the whales as they proceed North.

Others have passed up the sea of Behring or Kamtschatka, North through Behring's Straits into the Arctic sea, where whales are found large and plenty; sea smooth, and weather in the summer months (from the extreme length of the day) favorable for whaling. Several ships have been whaling successfully in those parts. The polar whale (as it is called) yields very rich oil, and the bone is larger and longer than that of the Northwest Coast, and fetches a better price in the market.

A free communication by our whalers through those remote seas, will develope the phenomenon of winds and currents there; they will also, in cruising for whales, discover the hidden dangers, (if any,) and thus contribute to assist the hydrographer in preparing charts to guide future navigators.

Herewith I forward you a history of the sperm whale, by Capt. F. Post of this city; also the history of Nantucket, the once great whaling nucleus of the world, from which you can find many useful statistics of early whaling."

History of the Spermaceti Whale, by Captain Francis Post.

"It is a matter of much surprise, that, while the whale has been so long and so extensively an object of commercial pursuit, so little should be generally known of the animal.

There is, perhaps, scarcely a being in the animal world, at least not one whose existence has been so long known, the habits, structure and qualities of which are less known to the naturalist than are those of the whale. It is a very prevalent opinion that whales spout water—Morse, in his American Geography, tells us that whales spout water to a great height, and we find many writers have been led into the same error; but it is well known among whalers that whales never spout *water*, and that their spouts which are simply dense respirations emitted with some force from their large nostril, never ascend above twelve feet high; and when the whale is unmolested, seldom to that height, or to one half of it.

The Spermaceti Whale has but one spiralle through which it respires, this is on the left side of the upper part of the head, and within a few inches of its end; it is about fifteen inches long when closed and when extended, from five to six wide. The spout shoots obliquely forward and upwards, expanding when it rises like a whiff of tobacco smoke, which it much resembles in form; it is visible but for a moment: is near the same density as fog, and when blown in the face, the same degree of dampness is felt from it. When the air is clear and cool, and a moderate breeze is blowing, so that the sea is not much ruffled, the spout of a large whale may be seen from a ship's masthead the distance of nine miles,—the white spout forming a fine contrast with the blue field above which it rises, and appears at intervals of almost as much exactness as can be measured by a first-rate chronometer. When whales spring out of the sea, the spray produced by their fall is so great as to be seen 15 miles—in one of these playful gambols they are frequently first discovered.

The males of this species are out of all proportion the largest, and they are generally found alone; it is

then quite astonishing to see with what exactness they pursue their course. Not unfrequently they are pursued by a ship the space of a whole day together without altering their course a single point of the compass. What can enable these inhabitants of the deep to thus pursue an undeviating course for a day, and most likely for as long a period as they choose?

So far as our knowledge extends the inequalities of the earth's surface beneath the sea, are similar to those above, and the conjecture, therefore, is a reasonable one, which supposes that the utmost cavities of the sea, do not exceed the loftiest heights above it. May not then these occupants of the watery world, like those of earth and air, be guided on their way by visible objects? For without such guidance, no animal, man not excepted, can long pursue an unvarying course. Instinct may urge the animal *when* to move, but something discernable must aid its way through the deep with such precision. Nor is it at all unreasonable to suppose that, by a wise provision of nature, their organs of vision are as well adapted for the watery element, as ours are for the ærial one.

These large whales generally spout from fifty to sixty times when to the surface, and the spouts appear at intervals of about fifteen seconds, though when the whale first appears they are rather more hurried than afterwards, this occupies nearly a quarter of an hour, after which they go down, and stop beneath the sea an hour, or an hour and a half, but never exceed this before they return to the surface again for the purpose of respiration. Thus between one-fourth and one-fifth of their time is occupied in sustaining vitality, by breathing atmospheric air. The periods of time passing while the whale is in the depths below are often nicely measured. In one instance the writer was in pursuit of a whale which was going quite fast nearly a day, and all this time he never stopped beneath the surface more than fifty-two minutes, nor less than fifty; he spouted no more than 48 times at a rising, nor less than 46. His other movements were equally uniform.

It is observed that whales suspend their breath longer in some seas than in others, probably because they go deeper for their food. Some idea may be given of the depth to which they go, by stating that when harpooned it is sometimes necessary to connect three or more lines together to prevent them from escaping. Each of these lines is commonly 225 fathoms long, so that if a whale take from boats four of these lines there is attached to it a continued line nearly a statute mile. It would not, however, go the whole depth; but, unless the descent was perpendicular, the whale's course would describe a sort of curve, and from the great length of line out, and pressure of the sea on it, the whale would continue to take line from the boats until it reached the surface, or nearly so; when in this condition the whale appears, it is generally found in an exhausted state, arising principally, it may be supposed, from its fright and struggles to get free, though some conceive it to be produced by the weight of the vast volume of water that must have pressed upon it while in the sea beneath. But this latter hypothesis seems rather untenable, for though the pressure may be great, yet if small fry, such as are caught from an hundred fathoms or so, can bear this pressure, then one bulky whale is not likely to get squeezed beyond endurance in the deepest cavern of the sea.

Spermaceti Whales are rarely, if ever, seen on soundings, though they are often seen and taken near land; but in this case there is always a bold shore and great depth of sea.

It is difficult to assign a reason why these whales are so partial to a deep sea, when all other kinds frequent shallow bays and harbors. Cuttle or squid, supposed to be the only food which sperm whales ever eat, are often found in shoal water; there is however a species of this fish, the exact size of which is not known; but it is presumed to be large, as whales, in the agony of death, frequently eject from their stomachs pieces as large as the bulk of a barrel, and these in large quantities; so that the assertion of the naturalists that the whale, though the largest of animals, is one of the smallest eaters, is untrue. Large pieces of squid are often seen floating on the sea, which whalers consider indicate good whale ground.

The manner in which they take their food is rather curious, and affords a singular specimen of animal ingenuity. While the whale is making little or no progress though the sea, its capacious mouth is extended, by having the lower jaw dropped down, and the inside being white the squid dart swiftly in. Whales are often seen in this position, and it is known that squid will spring at white and shining objects in the sea, for in this way are they caught. But for this stratagem, the whale might seek other food than the squid: for they are extremely active, and if pursued, could, by frequent evolutions, easily evade the pursuit of a whale.

The general color of this species of whale is a dark bluish grey, though some have large and irregular formed spots of white on them. The exterior surface of the animal is a thin tender substance of a glass-like slickness, which is easily broken, and forms what anatomists might call the cuticle; beneath this and upon the blubber is a short, soft, furry substance, that covers the whole whale. The blubber is of various thicknesses upon different parts of the body, and may average about 9 inches, though this depends wholly on the size of the whale. Some of this species have yielded 120 bbls. of oil, and as this comes only from the head and blubber, some notion may be formed of the enormous bulk of a large whale. Such a mass of animation cannot weigh less than sixty tons, and yet this animal, by all odds the largest that now exists, and unquestionably the largest that ever did exist, has, by a love of the marvellous, been greatly magnified; when we are told that whales have been found to measure 160 feet in length, we cannot say, that

"Travellers ne'er did lie."

That they are, or ever have been formed of such prodigious length, is wholly improbable; that sword fish and thrashers attack them, is equally so. But lay hyperbole aside, and reduce the size of a whale to flat reality, and it is then certainly a monster to excite our wonder.

The following are the dimensions and admeasurement of a large sperm whale that yielded 95 bbls. of oil; and it may be asserted without fear of contradiction, that the description of one which makes the dimensions exceed these more than a few feet, is entitled to no credence. The whole length of the whale, from the end of the head to the end of the tail, was 62 feet; circumference at the largest part of the body 32 feet; head 20 feet long, under jaw 16 feet long, and contained two rows of teeth, 22 in each; (the upper jaw has seldom any teeth, and when it does they are very small.) The tail was 6 feet long and 16 broad. The head usually yields about one-third part of the whole quantity of oil produced. The tail of the whale, like that of all the cetaceous tribe, is horizontal to the body; and when wielded as it is by a great number of sinews, some of which are as large as a man's wrist, forces an irresistible blow, to which a cedar whale-boat forms a puny shield. The tail

is between a triangle and semi-lunar form, and is the principal organ for impelling the whale along. The two pectoral fins serve rather to guide than to produce its motion. From the head to the hump, the whale approaches to a circular form; from thence the body terminates in an uneven ridge above and below, and diminishes in size till at the junction of the tail, it is not above 6 feet in circumference; this hinder part of the body measuring much more vertically than horizontally. The hump is a protuberance on the whale's back about 2 feet high, and when the whale is swimming along the surface this is seen elevated so much above it. The whale has no external ears, but two small apertures for admission of sound; the eyes have moveable lids, and are between three and four inches in diameter.

In comparison with the males, the females are diminutive, a full grown one of the latter not exceeding in bulk one-fourth of that of the former, and seldom making more than 20 bbls. of oil, often much less. They are found in herds together with their cubs, varying in numbers from fifteen or twenty, to above an hundred; among them are some scarcely ten feet long. The writer had one of these nursling cubs hoisted on deck whole, which measured 14 feet in length, and yielded no more than 20 gallons of oil. This afforded an excellent opportunity of examining the internal structure of the whale, and on an occasion like this, the young whaler is never backwards in doing so, as by observing the position of the seat of life, he is enabled afterward to point his lance with a more deadly aim. Though it be somewhat perilous, an encounter with one of these immense herds is a whaler's delight, since sometimes no less than eight or ten reward the adventurous exertions. It is a singular fact that when one of these whales is harpooned, though the herd, or shoal, as it is commonly called, be separated some miles apart, it is instantly perceived by the whole, and they either rush with great velocity towards the wounded whale, or decamp and leave it to his fate. If the whales surround the wounded one, they of each boat may select one of them for themselves; and when they are killed, to prevent their being lost, (for as they are near the specific gravity of the sea, but a small portion of their bodies remain above it,) a hole is cut in each whale, and a pole some 15 feet long, with a small flag affixed to its upper ends, is placed vertically therein. This done, the boats may go in pursuit of more, as there is now no danger of their being lost, and they may be taken alongside the ship at leisure. But it often happens when a whale is "struck" in one of these large bands, that the others all seek safety in flight, and then the whalers must content themselves with *slim fares*.

Either a whale's sense of hearing must be singularly acute, or else its vision is very powerful in a clear aqueous medium, for by one of these senses it is enabled to ascertain a long way off when another whale is attacked. Water, it is said, on account of its density, has the quality of propagating sound farther than the rarity of the air will admit it; though it has only been ascertained that sound can be transmitted far *over* water, not *through* it.

When unmolested, the velocity of whales is not often more than three miles per hour, though when alarmed and closely pursued, they are capable of swimming at the rate of ten miles per hour, but they never go long at this pace before it diminishes to four or five. On receiving a wound in the vitals they spout out amazing quantities of blood, so as to color the ocean for many yards around. Instances are common, not-

withstanding their mighty strength and size, of whales expiring in a moment after receiving their death wound. Sometimes in apparent fright they use every effort to escape from their merciless assailants, and not unfrequently in plunging into the depths of the sea and drawing all the lines from the boats, succeed in doing so.

When a whale is taking line from a boat, the utmost care is taken that it runs clear, as, should it become entangled and not instantly cut, the boat and all it contains, would at once be drawn beneath the sea. Many fatal accidents have occurred to whalers from being themselves entangled in the line, drawn from the boats and seen no more. In order for the whale to get no more line than is absolutely necessary, a strong piece of wood called a "*logger head*" is firmly fixed near the boat's stern; round this a turn or two of the line is taken, and it flies so swiftly round, that its friction would set the logger head on fire, if water were not occasionally thrown on the line.

Whales when attacked are generally passive, suffering the boat to approach, and the harpoons and lances to pierce their huge bodies without making a show of resistance, though serious accidents often happen, merely from the spontaneous movements of a wounded whale.

Boats in this way are often so badly stoven as to be rendered totally useless, and are abandoned on the sea. But they are not all thus unresisting; occasionally a large warrior whale is encountered, which proves himself a formidable and dangerous antagonist; that with a single blow of his ponderous tail severs the boat from which he is assaulted quite into halves, often to the destruction of part of its crew. But the terrible jaw of such a whale, set with a couple of score of large pointed teeth, constitutes his chief arm of defence, and wo to the thing in the shape of a man or boat with which it comes in contact.

Naturalists in their closets often make ridiculous mistakes in describing animals that are found in regions where they never venture themselves. Thus of the ——— and whale. "Both want *teeth* for chewing, and are obliged to live on insects." Again, "the whale pursues no other animal; leads an inoffensive life; and is harmless in proportion to his strength to do mischief."—(*Goldsmith's Natural History.*)

Sperm whales are not so gentle; the large males often encounter each other so furiously as to break off many of their teeth when the jaws come in contact: and they have been taken with their jaws broken. Instead of fleeing, a warrior of this mettle resolutely maintains his ground, and even in turn becomes the assailant, chewing in pieces every boat that approaches him. These desperate whales, after much hard fighting and imminent danger, are sometimes conquered; but so obstinately, and so successfully have they been known to defend themselves, that instances are on record, where all the boats of a ship, save one, to convey the drenched crews back, have been chewed into atoms, and the whales themselves, after defying all the resources of art, and disdaining to flee, have been left in full possession of the field of battle. We have heard of more than one case, where as a *last resort*, the ship herself has been run alongside of a whale like this, and while passing by, lances were so skilfully thrown, that he ultimately died of his wounds, and became at last a prey to his captors. But an attack in this way is certainly hazardous, as all will agree who remember the fate of the whale ship Essex.*

* This ship was attacked and sunk by a whale; the mate and part of the crew, who took to their boats, were brought home from the Cape of Good Hope in the U. S. S. Vincennes in 1829, in which ship I was then serving as midshipman.—M.

The Sperm whale is remarkable for yielding the unctuous substance whence comes its name; and it is also remarkable for producing ambergris; the bowels of a sperm whale forming the only situation where this singular fragrant substance is generated. Whether its existence is a cause of, or the effect of disease, is not yet known; it rarely occurs, not perhaps in one whale out of a thousand.

They seem to be more migratory in their habits than other whales, occurring in every parallel of latitude between the two polar seas, down to an equatorial one: though generally preferring the deep blue sea that indicates unfathomable depths.

As they are thus widely scattered, they are searched for in almost every sea, however remote, and hence it often occurs in voyages of 3 or 4 years duration, that ships before completing their cargoes, entirely circumnavigate the Globe. They are occasionally seen in the Atlantic and Indian oceans; but are found in greater abundance in the Pacific, where they are seen at times in favorite spots, scattered over the whole extent of this great sea. When half a century ago, our ships first ventured into the Pacific in quest of sperm whales, the coasts of Chili and Peru abounded in them; and our hardy pioneers in this daring occupation were there enabled to fill their ships, without the necessity of penetrating farther. But the whaling fleet increased extensively; the persecuted whales were in a measure killed and driven from their haunts; so that later voyagers to insure success, have been compelled to push their adventures into still farther and comparatively unknown seas. One unexplored track after another has been traversed, until it may now be said that from Chili to New Holland, from California to the Japan Isles, and China sea, with the whole intermediate space—in a word, over a square expanse comprehending above eighty degrees of latitude, and more than one hundred of longitude, there is scarce a spot of any extent but what has been furrowed by the keels of a whaler, and been a place of privation to her enduring crew.

Zoologists have classed these animals, as well as the sporting tribe, among fishes, distinguishing them by cetaceous order, comprehending a variety of species. But on an examination of their structure and functions, the impropriety of this classification is manifest; and the inspector is at once convinced of their being far removed, or in fact wholly distinct from any species of fish. They have many analogies with the larger land animals, having in common with them, warm, red blood flowing through the system, though a certain modern philosopher has asserted to the contrary: Robert D. Owen, in one of his published letters while in America, skeptically comparing his situation in a stage coach to that of Jonah in the whale's belly, asserted that the whale was a "cold blooded animal."

They have a heart, with auricles and ventricles through which this fluid is propelled; they have lungs, together with all the functions for breathing atmospheric air, and they can only suspend this breathing for an hour or two at a time. Being entire tenants of the deep, and having organs for propelling them through it, are the only fish-like qualities they possess. They seem to form a sort of intermediate and connecting link between *absolute beasts*, and their more near submarine neighbors.

It is highly creditable to the spirited and enterprising individuals, who have put forth their capital in ships, destined to traverse the deep in quest of these oily monsters, that they have become so numerous as to form

a large and important portion of our navigation; and this, without ever receiving, without ever needing, legislative encouragement. A computation roughly made, shows that we have now whale ships enough, if placed in a direct line, equidistant and just in sight of each other, to form a continued fleet, that might reach more than half way around the globe. The wealth drawn out of the deep and conveyed by them annually to the shores of America is immense. But aside from contributing thus largely towards our national wealth, no small degree of honest pride arises from the knowledge that no nation can rival us in this perilous branch of industry. The English have, it is true, been for many years engaged in it, and with partial success, but the immense amount of bounty paid by their government to encourage the establishment of one branch of whaling alone, shows how reluctantly they have been drawn into it, and fully justifies us in saying, that, in this pursuit as in others that call forth daring energy, Old England must yield the palm to *New England* adventurers.

From the commencement of the whaling career of the English in the northern seas, down to the year, 1786, that government had paid bounty therefor, amounting to £1,266,000—a fraction or so of the national debt. To ensure success in their whaling operations in the South seas, the English as well as their neighbors across the channel, have not scrupled to secure for their ships, masters and other chief conductors of whaling voyages from the young country that first led the way beyond the two fellow capes, in this great marine enterprise. So liberal in fact were the inducements held forth, that merchants as well as seamen removed from our own to their countries, invested their funds, and became actively engaged in this venturesome pursuit. So far as we know, a detailed description of the manner of capturing, cutting in, and trying out a whale, has never been given; the following may, therefore, supply the place of a better one.

It may first be mentioned, that when a whale ship leaves her port, a man is stationed in the top-gallant crosstrees of each mast to look out for whales, and the mastheads are kept manned from daylight until sunset, during all weather that admits boats to leave their ship, from the time of her leaving home until her cargo is completed, or the voyage terminates; the ship's company standing watch aloft by turns of two hours each. When the spout of a whale is descried, the discoverer immediately makes it known by the welcome, and—on board of a whaler—the well known exclamation of "There she blows!" which is repeated often, as the spout appears in view; and though it should be so far off as to be but just discernable, yet by its peculiar formation, as well as by the number of times and regularity with which it appears, the experienced eye of a practical whaler can distinguish at once from what species of whale the spout proceeds. If it be a sperm whale, and not to windward, the ship is instantly headed for it, and all sail made in pursuit. After some few preliminary observations, such as noting time by watch, and with a spy-glass tracing the animal's way through the sea, its course and rate of going are ascertained, and it now may be calculated for with tolerable precision.

The ship is usually run within a half mile or so of the spot where the whale is expected to appear, when it rises to the surface, and by having the courses hauled up, and one of the larger topsails hove back, she there remains nearly stationary. The boats are now sent off, and are rowed in different directions, so that if the whale is not going fast, at least one of the boats is nearly sure of being near him when he rises, or should he chance to come up a mile from the boats, they can generally reach him before he has his spoutings out; as

this occupies some fifteen minutes, and the boats may be rowed at the rate of six miles an hour, even over quite a rough sea. If the whale be slow in his movements, the boat's crews have nothing to do while waiting for it to appear, but to lay upon their oars; and as the time draws nigh, eager eyes scan all portions of the sea around, to catch the first glimpse of a rising spout. But if there happen to be much swell, from the depressed condition of the boats, being often in a cavity between waves that entirely obstruct the vision, it is difficult to discern a spout from boats beyond a limited distance; in this case, the main dependence is placed on the man at the ship's masthead, who, as soon as he sees the whale, runs up a signal and points out its direction. This creates a scramble among the crews, as there is generally no small share of rivalry existing among them, and all strain every nerve with the view of being the first who approach and have the honor of first implanting their harpoons in the whale; but as the boat which is more favored by chance, or happens to out-row the others, gets within a few yards of him, the contested race is given up, and the sternmost crews cease rowing and silently await the issue of the first conflict. Sometimes boats approach a whale, as their situations chance to be, by rowing up towards the head and get to the pervious part of its body in this way; at other times they proceed direct to its side, but generally the most approved way is to row up from behind, and if necessary, make a circuitous route to do so. The approach of a boat often alarms a whale, when he dives beneath the sea and suffers it to come near him no more; but more commonly and especially on new grounds where they have been but little disturbed, there is no difficulty in placing boats sufficiently near whales as to leave them in the attacker's power. It is probable, however, that boats seldom arrive near whales without their knowledge, such only making efforts to escape as have learned to regard them as enemies by having become acquainted with the missive weapons thrown therefrom. The harpooner rows at his oar until the boat gets nearly "within dart," when he is called up by the officer who steers and controls the boat; and when within a few feet of the whale the progress of the boat is checked as much as possible, by strokes of the oars. The harpooner now darts his two harpoons which pass through the blubber and enter the fleshy mass that encloses the bones of this great animal; and these keen instruments coming in quick succession often give to the affrighted whale the first intimation of impending danger. This is always a moment of peril to the assailants, and therefore one of anxiety to the lookers on; as some fearful accident might proceed from the convulsive motions of the wounded whale, other boats promptly row up to assist the first. The skill and activity of every one are now in requisition, lest the yet slippery and valuable prize should by some means escape before receiving his death wound. If, as often happens, a boat is badly stoven in the first outset, another takes in the immersed crew and tows the stoven boat to the ship, while others make a fresh and combined attack on the whale, which may now be rolling in the ocean foam, that his own struggles have produced, or perhaps rearing its mighty tail in the air, and drawing it down on the sea with such force as to make it resound to a great distance.

Soon as a boat is attached to a whale, the officer in charge exchanges situations with the harpooner or boat steerer, as he is more generally called, the latter now steering the boat while the former goes forward and plies his lance, taking care to poise it well before throwing it, and to aim it always so that some portion of the whale's vitals shall be pierced. Copious emissions of blood then gush from the spout hole, rise up a few

feet, and fall into the sea, dyeing it with the crimson fluid wherever the animal pursues its way. Where a whale has fairly received its death wound there is but a small chance for escape, as it seldom lives above an hour or so afterwards. When dead, a hole is cut in the head or tail, through which a rope is rove, and if the ship is to the leeward the boats tow the whale towards her; but if the ship be to the windward, this labor is saved, as she then runs down within a short distance of the whale, where the fore topsail is hove aback, the whale is hauled alongside, and a cable of rope or chain put round its tail; preparations are now made for cutting in the blubber and other oily portions of the whale.

This is a laborious process which, for a large sperm whale, requires the principal part of a day to complete. The cutting operation is performed from stages suspended over the ship's side; the cutters being provided with sharp instruments for the purpose, called spades, these have a razor-like edge of fine steel, and are affixed to poles of convenient length. To make a beginning, a small hole is cut first in the blubber near the head, and into this is placed a blubber-hook, to which is attached one of the two large tackles employed in hoisting in the blubber, and by means of the windlass a piece of blubber about six feet in width is thus raised up to the ship's side. As this goes aloft the whale rolls over and over, the blubber peeling off rapidly as it rolls; and as the cuts are made not quite circularly round, but in a direction somewhat obliquely towards the tail, the whole blubber comes off the whale in one continued piece, being stripped off in the spiral way from head to tail. With the aid of the windlass, this piece of blubber is heaved some thirty feet above the deck, when the lower block of the tackle meets the upper one, which is suspended from the main masthead, a second tackle then relieves the first, having a strap of the block inserted through, and secured to the blubber near the deck; just above this block the blubber is cut off; the piece separated forming what is termed a "*blanket piece*;" this is lowered into the "*blubber room*," which is that portion of the ship between decks, directly abreast and beneath the main hatches; another piece goes up to the same height as the first, and is in the same manner cut off and lowered into the blubber room, and so on till all the blubber is taken from the whale, five or six of these pieces commonly taking the whole. The carcass is then abandoned to the ravenous sharks and hungry birds that surround a ship on these occasions. The carcass sometimes floats, but most commonly sinks.

While the whale is being rolled the head is cut off; and it remains alongside secured by a strong rope till the blubber is hoisted in.

Small whales' head are heaved on deck whole, but the immense weight of a large one renders it impracticable; it is therefore necessary to divide it. Both tackles are firmly hooked to a portion of the head, denominated the junk, and this when cut off requires the united strength of the whole ship's crew at the windlass to heave it high enough to reach the deck, a large one weighing at least between five and six tons.

The last and most remarkable portion of the whale remains yet to be hoisted in. This is what whalers term the "*case*;" it is a body of fluid head matter that often amounts to twelve or fourteen barrels, which when removed from the head, leaves a large tubular cavity that runs longitudinally its whole length. It is enclosed by a cartiligenous substance that yields no oil, and this again has an outer covering which is of an intermediate nature between blubber and a singular part of the whale called "*whitehorse*," which contains no oily matter,

and is impervious to all but the keenest instruments—a cannon ball would hardly penetrate it. This part containing the case is also too unwieldly to be taken in whole, and to subdivide it would cause a loss, as much thin oil would escape; hence it is necessary to raise it with the cutting apparatus perpendicularly up the ship's side, with its lower end remaining in and supported by the sea. A perforation is then made in the upper end with a spade and into this a bucket is placed which requires to be pushed down with a pole in order to tear away the tender membranous filiments that oppose its way; the bucket is then filled with oil, and by means of a pully is hoisted up and emptied into a receiver. In this way ten or twelve barrels of the oily liquid are obtained from every whale of a large size. It is necessary that this oil should pass through the pots and be heated to prevent its becoming rancid, though it may be mentioned that while fresh it is perfectly sweet, and like other animal fats only becomes rancid through age. While fresh, it may be and is sometimes used on board ship for culinary purposes. A certain species of Yankee food called "*dough-nuts*," fried in fresh oil, occasionally adds variety to the homely and too often scanty board of the whaler. Next to the case, the junk contains in proportion to its bulk, the largest quantity of oily matter; much of it yielding its own bulk in oil, and while it is being cut into smaller pieces the oil exudes so copiously that it is necessary to stop up the scuppers, and bail it from time to time off deck. The blubber between decks is cut into small pieces so as to be conveniently transferable, these are called "*horse pieces*," and in this form the blubber passes through the mincing operation. This is performed by drawing a long knife across or nearly though the pieces, cutting down portions from a half to three quarters of an inch thick; these are not entirely severed, but for the convenience of removal are kept hanging together somewhat after the manner of book leaves.

In this state the blubber is ready for the try pots, into which it is transferred with a fork or pike constructed for the purpose. A hot fire is kept up under the pots, and in an hour or less a pot full of blubber has all the oil fried out; "the scraps," are then skimmed off; more blubber is put into the pots and a sufficient quantity of oil is boiled therefrom.

The oil boiled off is poured into a copper cooler, and from thence it runs through a cock into a second cooler, and from this is bailed into casks which are placed about deck, and when the oil is perfectly cool the casks are coopered and stowed away in the hold.

If the weather is fair and the sea smooth, a large whale may be fried out in about 36 hours, which gives an average of from 2 to 3 barrels an hour; and if the whale be uncommonly fat, the oil can be extracted proportionably faster.

The scraps, it may be stated, form a sufficient quantity of fuel, for continuing the frying process; this goes on night and day, the ship's company being divided into two watches who perform duty alternately.

It is somewhat remarkable that in this age of invention, there has been no new method devised for capturing whales; nor any improvement made on the old one, nor yet on the simple instruments used against them.

The plain harpoon employed by the early whalers, is still in use, although there have been various modifications of this form; such as, harpoons with one flue, those with joints, others barbed, &c., &c. But these have all had their day, and given way to the plain primitive harpoon.

There have indeed been some curious, but theoretical rather than practical, machines constructed for "*Shooting whales*," and also fanciful contrivances designed to explode in the animal and blow it up. But nothing has yet been fabricated for sending a harpoon, that is at all comparable to a pair of nervous and dexterous arms, more especially if these happen to belong to a stout heart. That however a portable piece of mechanism can be put together which will fully answer the end of throwing the missive weapon and destroying the whale with less risk of human life than the means now employed, is undoubtedly within the bounds of possibility. The chief difficulty, however, seems to be that of constructing an engine of this sort which shall possess sufficient projectile force to enable the *shooter* to remain secure in the distance, and yet be of diminished size and weight, so as not to occupy much space nor add materially to the weight of a boat.

Whale boats are necessarily nutshells of fabrics, there being not a board in one, from the keel to the gunwale, that measures one half inch in thickness, and this of the lightest material."

From Capt. Daniel McKenzie to Lieut. Maury.

NEW BEDFORD, *June* 8, 1849.

"SIR: Having perused the foregoing reminiscences of my friend Capt. Post, who is an intelligent sailor, and has commanded a whale ship on several successful voyages, I have no hesitation in saying they entirely agree with my views and experience; hope, therefore, they may be found useful to you.

Having copied several of Capt. Post's sea journals for you, in one of which found the foregoing, (written out probably at sea,) and being much in detail, possibly may assist you in your great work; have therefore taken the liberty to forward them."

The same to the same—New Bedford, June 18th, 1849.

"Your communication of the 13th instant is received, contents duly noticed. I am most happy to learn that the books and letters I sent you in relation to sperm whales, &c., and also the statement wrote out by Captain Post, will be found useful. Captain P. is now absent, he commands the Barque Pliades of this port, and is on his passage to California on a gold-digging expedition, and has your charts from me; he will probably return you a valuable abstract log of his voyage.

You mention that you 'should not infer from the chart which is devoted to the whales, that the sperm whale has so wide a range across the ocean, as I and Captain Post seem to think, and should say the sperm whale in the Pacific is found almost exclusively within the tropics, or rather within 30° each side of the equator, and that the right whale is as seldom found within that zone as the sperm is found without it.'

Your inference (as a general rule) from the records you have had of the haunts most frequented, and long cruised around, both for right and sperm whales, is correct; that right whales are always found without the tropics is true, with the exceptions of a very few instances where cows in cruising along a coast seeking a still bay to calve, will enter the tropics, but their home and food is always found in a high latitude, and are sought after between the 30th° and 60th° of latitude, generally from 35° to 45°.

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The sperm whale has (as you remark) generally been sought after and found within 30° each side of the equator, and as long as they can be found in a friendly clime, where the sea is smooth and weather pleasant, they will be sought after there, and probably they would remain in low latitudes where the sea is smooth and their food abundant, if they were not harrassed, wounded and frightened away. Be this as it may, you may rely upon it, sperm whales are found, and many thousands of barrels of their oil been taken off the S. W. coast of Chiloe and off Gaufor, latitude 44° S.; also off the Chatham Islands, latitude 44° S., and amongst the Eleoutian Islands, (N. Pacific,) latitude 53° N. But after all, the great bulk of the fleet will be found cruising in every sea from the equator to 35° each side.

You ask if 'I or Captain Post, or some one else cannot give a similar chapter on the right whale, and if they and the sperm are ever found together, and if they fight.'

In my letter of the 5th of February, you will notice my description, somewhat in detail, of the habits of the right whale. The right and sperm whales, though sometimes seen near each other, I have no idea they ever mix, mingle, associate or fight; their food being entirely different, they are a different animal, having no affinity with each other, nor have I any knowledge that right whales ever fight each other; they seem to be lonely in their habits, sometimes they go in pairs, and at other times 4 or 5 will be seen together, but when they couple or cohabit together they meet indiscriminately and seem to indulge an indiscriminate intercourse. Shoals of each sex meeting together,—at this interview the bulls particularly are very wild; they bellow and roar like lions, breaching, rolling, and threshing about, lashing the ocean to foam with their huge flukes; and seem more intent on business than pleasure; it is exceedingly dangerous to attack them at this time, this mad phrenzy is soon over, when they separate, and resume their lonely wanderings over the ocean for food.

The charts you sent I will distribute with a special request 'to use the water thermometer freely.' It would give me great pleasure to furnish any additional remarks or thoughts upon whales. I do not know at present anything more I can write; should you wish me to investigate further, you will please inform me, and I will if possible comply."

Extract from W. S. Haven's letter to Geo. Manning—Sag Harbor, Sept. 17th, 1849.

"Your first question is as to the yield of the whale; Answer, Mr. E. says the largest whale taken in the Polar sea in the Superior made 180 *barrels*, the smallest made 120 *barrels* of oil, of a good quality, limpid, and equal to the best oil found in the whales taken on the coast of Kamschatka. Your next query, 'do the whales sound under the ice?' Answer, they saw no ice, therefore cannot tell whether they do or not. Question, 'if he has any bones (so I read it) should like the loan of them:' Answer, he has none, neither has he any drawings of any kind of whale. The description he gives is as follows: The whales taken in the Polar sea were all of the Right or Black Whale species, of a deep black color, having head much longer than the black whale usually has, and more crooked, drooping at the extreme, and without the protuberance near the end technically called the bonnet in other whales; saw a few white flukes or tails as you would call them; the head being longer; the whalebone was found of a corresponding length, being also much longer and smoother but not so

thick as N. W. Coast whales; brings a better price in market; comes from the whale clean without the roughness usually found on bone from other whales; their spout holes are much higher than other whales of equal size in other respects; some of them were found with a hump on their backs like the Spermaceti Whale; saw no calves, found none in the cow *whales* in cutting; took a number of cows; their feed was of a different kind from that found in other *Oceans*—not the red brit, but a paler substance, probably some oceanic animalculæ which causes the water at times to become thick; found the *whales* gentle and plenty; I believe I have answered your questions as fully as I can with the material at hand: if you require anything further I shall be happy to furnish you with any information I can obtain. Mr. Eldredge is not so communicative as some men, —very ready, very willing to tell you all he knows, but is not a talker, but requires a question to draw information from him. I hope you will furnish him with a set of charts, should he require them hereafter. In regard to whales crossing the line, I say with Mr. Eldredge, no! no! no! decidedly. Black whales are sometimes found as low as 18° or 20° from the equator, about the bays, in looking up places for the delivery of their young; but in all my experience I never heard of a whale in the open ocean nearer than 25° of the equator of the black whale species. I am therefore fully of the opinion, after crossing the equator twenty-four times, that black whales never cross the line, in which opinion I have all of our Sag Harbor whalemen agreeing with me."

Walter R. Jones, Esq., to Lieut. Maury—New York, September 20, 1849.

"Your esteemed favor of the 15th is received, and I am pleased to find that you are engaged in ascertaining the habits and the different kinds of whales of the different oceans, in addition to the other scientific and useful researches and discoveries that you are making; and it will give me pleasure to aid you if I have it in my power to do so.

The right whales differ very much, as you are well aware, and are very different in appearance and size in different latitudes. By uniting the observations of seamen, and comparing the dates with the places where whales are seen at different dates, you will contribute in determining the places where they may be expected to be found at different dates in successive years, and thus facilitate the operations of whalemen in taking them.

Our whaling masters tell me that it is a common occurrence to find the right whale in great numbers remaining stationary at their feeding place for a considerable time, when they suddenly start off in a particular direction, when the whalemen by exerting the greatest skill are only able to keep up with them a short time, and very soon they disappear entirely.

I cannot give you much information in relation to the important question you wish to solve as to the northern communication between Behring's straits and Greenland sea and Davis's straits. The whaling in Davis' straits and Greenland is now almost exclusively carried on by English whalemen. Indeed I do not know and never did know of but one American ship engaged in the whaling business to Greenland and Davis' straits; that ship is the McLellan, commanded successively on her three voyages by Jackson, Whipple and Chappell, and is expected to arrive at New London next month; the third mate of her on a former voyage has

since been with Capt. Middleton in the ship George and Mary of New London to the Ochotsk sea, and says that the large common whales of Davis' straits and the Ochotsk sea, out of which the ships usually make the chief parts of their cargoes, are exactly alike. Other men who have been in the McLellan, are probably by this time in the whaling business in the vicinity of Behring's straits, who will be able to give more particulars in the course of the ensuing year, when more complete, more certain, and more satisfactory answers may be obtained.

Capt. Thomas B. Roys made a voyage in the ship Superior of Sag Harbor last year, and procured a full cargo to the northward of and inside of Behring's Straits. He is probably the first American shipmaster that has entered that sea; he told me that whales commonly taken in the vicinity of the straits are generally large, fat and sluggish; and he also found there several other kinds of whales of smaller size, one of which kinds differed from any he had before seen, having a horn on the end of the head, which this species of whale use for rooting up their food from the bottom, and differs from every species of whale he had seen in other places; and he also spoke particularly of the whales taken in latitude 50° to 60° North being much more active and fierce, and more difficult to approach and more dangerous to take than those in latitude 70° in Behring's Straits. He is now in command of the ship Sheffield, chiefly owned by myself and brothers, which vessel left here the 18th August for San Francisco and the Sandwich Islands where he is to complete his outfits for another whaling voyage, during which Capt. Roys intends again to go through and to the north of Behring's Straits. I am also interested in the bark Alice, Captain A. D. Smith, which vessel sailed the first of this week; and in the ship Huntsville, Captain Freeman Smith, to sail in the course of the next month. It is expected that these Captains will all pass Behring's Straits early in the spring, and either of them will be willing to comply with any requests you may have to make. I can hand to Capt. Freeman Smith any communication you may wish to make to him, and I can send to Capt. Roys by the overland route via Panama to San Francisco any communication you may wish him to have; both of which I will forward with great pleasure. I make this offer, supposing you may have suggestions to make in addition to the one of bringing the skull bones of one of the whales of the West Coast.

Capt. Roys thinks there is land or very shoal water to the North of Behring's straits, as he found the soundings diminished as he sailed North; he also found on his entering the straits in the month of July an insetting current apparently dividing, and the strongest part of it running to the Northeast along Georgia, and another part setting to the Northwest, at a time when it was supposed the melting snows and ice would in the spring force the water outward; instead of which on his outer passage in September he experienced a diminished outward current setting to the South.

Messrs. Perkins and Smith of New London, the chief owners of the McLellan, will probably fit that ship again, in which case I have no doubt of their willingness to do anything in the way suggested that you may wish. Should that ship not go, the only way to procure a skull would be by asking the master of one of the English whalemen from a Scotch port to procure one, as they will have that business exclusively if the *McLellan* should be withdrawn, which I hope may not be the case."

C. B. Chappell to W. R. Jones, Esq.—New London, October 25th, 1849.

"Having been requested to furnish a description of the Greenland whale and its habits, I comply with pleasure in furnishing what information my experience in the country will afford.

First then I will state, that there are two kinds of whales in the Greenland seas, the first of which is found in latitude from 59° to 62° North, and invariably close to the ice, which at different seasons extends farther to the eastward, sometimes as far as 55° of longitude West; but as the season advances from March, the ice gets broken and squander in April and May. The whales seek their food and protection from rough weather among the ice, and always the heavier ice in preference: towards the land to the westward, and where there is no ice, they are seldom found and never at rest. The currents here set to the S. E. These whales have a long crooked head, perfectly smooth, with a very high crown or spout hole; measures not more than 50 to 52 feet in length, having a small ridge or hump near the flukes, but not like the sperm whales or hump-back. When the ice is gone these whales seek the land and go up the floe which runs far inland towards the West. The whales farther North, in latitude 68° near the island of Disco, have no such hump, but whose habits are the same. From Disco Island, the currents are found to set from the westward, which clears the ice from the land on the East side of Davis' straits, and leaves water for the whales in this vicinity.

The current at the same time presses the ice over to the West side, baring the passage of the whales up Hudson straits in the early part of the season; but after June comes in, the ice becomes more open and the whales can pass through to the West land, where in general there is a strong land ice, in which if there be no cracks or holes, they remain a short time in quiet. In the early part of July, whales are found to be going to the westward very quick, up Lancaster sound, and in large numbers, where it is supposed by all men that I have conversed with on the subject, that if they meet no firm ice across the sound, they continue their passage either through Barrow's straits down to Hudson bay, or farther to the North and westward through the unexplored regions. Some seasons they have been found, after going up Lancaster sound and being gone for a while, to return to the southward. From this we must suppose that the ice was so strong that the whales could migrate no farther West, and the frost setting in obliged them to seek a passage farther South. When it happens that they come South they keep the land, and generally at the mouth of some deep inlet seek inland again; and finally, when in September, if there is any ice in the straits and any whales, we find them with the ice. We seldom find whales to the northward of Lancaster sound in Baffin's bay. But in former years it has been said they were quite numerous in latitude 76° 35'. Off Pond's inlet in latitude 74° North, longitude 76° 30' W., we find whales coming from the middle of the straits; and if the land ice permits, they go directly up the inlet; if not, they remain awhile, then make up the sound. In March we find the old whales with their young in latitude 50° to 62°. In August we find many young ones in latitude 74°, yielding from 50 to 60 barrels. The largest one that I have seen taken yielded 175 barrels and 2,200 pounds bone. About whales stopping under the ice, I would say that they can at certain seasons stop beneath the water according to their own pleasure, or as nature, according to my own judgment, has created them to lay at bottom dormant for a length of time. I am strengthened in this belief by hearing the Governor of Disco relate the fact that he saw a whale lying at the

bottom near the Harbor of Liefly on Disco Isle for seven weeks, and that he visited the spot each morning on the ice beneath which the fish lay for this length of time, and then arose to the surface and was captured. I do not remember at what season of the year this happened. What I have seen of the whales, their average length of stopping down is one hour and fifty minutes, and remain above about twenty-five minutes; but when amongst the ice we seldom see them more than two risings, and many times never see them after going down. When they are irritated by having the harpoon stuck into them, they do not stop down so long as when disentangled; and still I believe I have seen a stuck fish stop down over two hours and come up apparently out of breath; and have seen them when I supposed they had made much exertion to pass under a heavy floe of ice, and that they could not pass it, was obliged to return again completely out of breath. At such times they are captured without a move to get away. I have seen a whale in a hole in the ice lay without going under for four hours, and if not troubled probably would have lain longer. It is my belief that these whales do emigrate to the West, and that there is a passage for them beneath the ice to seas beyond these sounds, or we should meet them oftener going the other way, which we never do. These whales do not require a large hole to breathe through; have often been found dead in the vicinity of Lancaster sound, with no mark upon them, in numbers. From what I have heard, I believe them to be the same as the Polar or Russian whale, but never saw one."

Captain Roys to Lieut. Maury—Hong Kong, January 19th, 1851.

"I received your favor with pleasure, and am very willing to communicate any knowledge I possess respecting the whaling business. The whale of Behring's straits and Baffin's bay are the same; yet they differ very much from the Kamtschatka or Northwest whale, or the right whale of the South seas. I have known a whale to sound deep enough to take one thousand and fifty fathoms of line from the boats; yet I never knew a whale to remain longer under water than 35 minutes, of the right whale species; and one hour and 30 minutes for the sperm whale kind. I have never known them to sound under ice, that is, more than 30 feet above the water's surface, which was in the South seas. I have never seen any ice to the northward of Behring's straits more than 30 feet high. The right whale feeds upon a small animal substance, which seems to vegetate and come to maturity every year, and perish like the vegetation upon the land. And it is in only one state when the whale will eat it; consequently, in the northern hemisphere, in the month of January, the food is to be found from 30° to 35° North; and in February it is ripe for the whale; a little farther, in March; still farther, and so on, until August, when it is as far North as the Kamtschatka whales go, which is 60°; while the feed from 35° to 40° becomes dead and unfit to nourish the whale, consequently the whale cannot live at that season in those latitudes, while the humpback and finback take possession and seem to enjoy and revel in the food, after it has passed its stage for the right whale. The Polar whale's feed differs a little from the others, and in January, may be found in 50° North, and in August, from 70° to the pole. I am firm in the opinion that the South is the same; but as no one has ever yet seen a right whale the opposite of the Arctic whales, in the Antarctic, the matter still remains in doubt; and it is a lamentable truth, that the ships of war who have visited those seas are not able to tell us for certainty the kinds of whales they saw there.

It is not the easiest thing in the world to distinguish the different kinds of whales, even to those who have been in the whaling business, and a ship must be brought close by a whale to tell for certain his kind.

The sperm whale is found in all climates, and in every sea; he feeds upon an inanimate animal substance called a squid, which grows upon the bottom of the sea, and is never seen upon the surface, except when torn up by the whale. I have seen it in large pieces floating upon the surface. I have seen a dying whale vomit it up. I have opened the stomach of a whale and seen it there in pieces: which convinces me that the animal is very large, also as well as small; and that the sperm whale almost always, when in want of food, goes to the ocean's bed.

I do not know as I shall be able to procure for you a whale's horn, as they are difficult to take; but if no ill betide me, I will bring you the under and upper jaw of a Russian whale, which will be about 24 feet long by 16 diameter, which will serve to show the magnitude of this animal, and perhaps we may obtain the horn and something more.

I obtained the last season 3,200 barrels of oil, and 40,000 whale-bone, which I shipped from here to England, and try my fortune another season. I commenced whaling in 1833, at 17 years of age, and it has been the whole study of my life ever since that time; and I am writing a book with all the knowledge I possess, giving a particular description of all kinds of whales, with all my opinions, &c., which I will forward unto you upon my return to the States. I shall sail from here the 10th of February, and expect to be in 60° North on the 20th of March. It would require too much paper to send, by mail, full answers to your enquiries, and I can only say, that I heartily rejoice that we have one man in our Government who will condescend to take notice of a business whose annual income is millions, and at the present time has broken down all competition of other nations, and is supplying the markets of the world with oil. I shall also be able to give you some of my opinions of ocean currents, &c. I have a set of your Wind and Current Charts, which I am happy to say, I consider very useful, and have found them so. When I arrive at home, you will hear from me soon."

Capt. McKenzie to Lieut. Maury—New Bedford, May 22, 1851.

"Your communication of 20th inst. is just received, contents duly noticed; in reply say:

It is both the right and sperm whale that is covered with hair,* but not on the *outer* surface. The hair is found between the two skins; the outside skin is thinner than the finest paper, separated from the second or inner skin by a muddy substance covering the whole animal a quarter of an inch thick.

In this muddy substance lays imbedded a thick coat of hair, (as whalemen call it,) nearly half an inch long, resembling the fine *fur* found on a seal after picking off the hair.

This is known to all who, for once, have witnessed the *cutting* and *boiling* of either of the above species of whale.

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* Captain M has since furnished me with specimens of this 'hair.' To the naked eye, it looks very like hair, but Professor Bayly, who has examined it with the microscope, thinks it is not hair.

I have the promise of several Captains (who are now out) to get for you a small piece of the skin of either right or sperm whale.

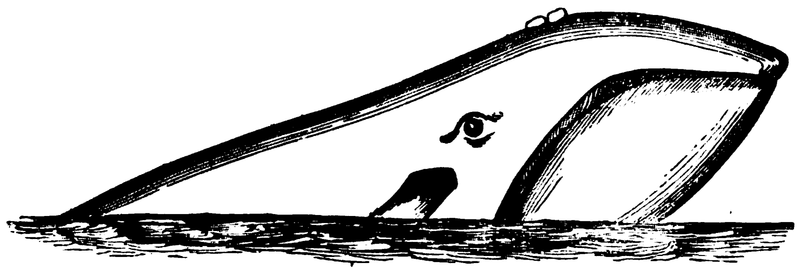
As the *Bowhead Right Whale* differs in form and spouts from all other whales known, I forward a sketch or diagram, showing their appearance as they lay swimming, and the form of the spouts. Also the shape (as developed) of that part which differs from the common kind when dead and on the surface.

The skin of the Bowhead is entirely smooth, of very dark color, with the single exception of two white bunches, each the size of an ostrich egg, forming the spout-hole.

I learn from Captains that the sea around where bowheads are found, is covered with parts of dead fish, and they suppose they were discharged from the whales.

Bowhead Right Whale.

Bowhead Right Whale.



The horn whale, or unicorn whale is smaller than the right whale. The horn whale, when full grown, is about 10 feet long; it projects ahead from the upper lip—is of solid bone—appears as if used by the whale for rooting out food from the bottom of the sea—probably a species of the war whale. Capt. Smith thinks they may prove to be the California Grey Whale. There is a marked difference between the Russian or Camel backed whale and the common right whale. The spout of the former is a perpendicular jet, running high and then branching off in two parts, one part falling over the head, the other continuing upwards until its force is spent, then falls towards the tail. The spout of the right whale is a low, bushy jet, flying in all directions. The Russian whale has a hump on the back from the centre of which he spouts. Immediately behind this hump, the back caves in. His tail is broad and nearly square. The right whale is smoother on the back and has a narrow tail."

From same to same—May 28th, 1851.

"I have received yours of the 26th instant, and duly noticed its contents. In reply: the hair does cover the right and sperm whale 'all over the body;' probably shorter at the extreme ends than on the body of the whale.

The right whale taken in *Anadir* and *Arctic* seas is somewhat different in its organization from all other right whales yet found; they are called *Bowheads*, having a curve down with their heads from the spout hole to the nose-end; so much so, as never to show their heads forward of the spout-hole—either when blowing or during their capture.

These whales are very *large*, *black*, and skin entirely smooth, no barnacles or other crustacea adhering.

They appear to be nourished by a different kind of food; their excrement, different; being *moulded* as if *costive*, and most, *exceedingly*, *horribly* fetid.

If this be true, and I am told it is, since they are found in shallow water, is it not probable they may feed on other fish, or on vegetable matter found on the bottom?

One of our most intelligent captains told me he struck a right whale in the sea of *Ochotsk*, which went down and remained half an hour, when he succeeded in disengaging himself, and thus escaped. On taking the harpoon on board, he noticed the hitches and searons were covered with mud, he thought the whale had been rolling on the bottom, and worked out the harpoons; the whale descended two hundred fathoms.

I intend calling on some of my friends, on their next voyage, to examine the contents of the Bowhead's stomach.

John T. Conklin, second mate of the ship Huntsville, has been four voyages on the Northwest Coast; two from Cold Spring, and two from Sag Harbor. Has never seen a sperm whale on the Northwest Coast; has seen them in almost all oceans in the Pacific, not higher North than 35°; in South latitude as high as 57°, off the pitch of Cape Horn in a snow storm. 110 barrels is as much oil as he ever knew a sperm whale to make, and so on down to 5 barrels; usual quantity 45 to 50 barrels. The sperm whales keep in warm latitudes, here, or on the equator, or near it.

The Russian whale has been seen as far South as 49°. The first he saw was with Capt. White in the Tuscarora—was then in the Ochotsk sea, in the Huntsville, about Lat. 61° or 63°; Long. 153° East. Land in sight 5 or 6 miles distant.

The quantity of oil from a Russian whale of large size 210 to 220 barrels, and down to about 90 barrels; usually, 175 barrels from each Russian whale. This is probably the same kind as are taken in Behring's straits. Find the common right whale in abundance here. Also, some call these Japan whales. These whales, Mr. Conklin thinks, are similar to the Greenland whale, but he has never seen the latter.

The right whale keeps to the North of 30° North, and South of 30° South—never go near the equator. Has heard of one taken near the Sandwich Islands or the passage, in about Lat. 19°; has taken one.

260 barrels down to 15 barrels, usually about 75 barrels, are taken in all oceans, except from 30° North to 30° South.

California Grey—usually 25 to 30 barrels. Fin-back:—does not chase them;—are not of sufficient value;—may make 15 to 30 barrels; some do not make any. Sulphur whale, about the same;—heard of one that made 60 barrels—are not sought after. Grampus:—are small;—may make a barrel or two;—similar to the Black Fish. Black Fish make about one barrel, and equal to sperm oil, and like the Fin-back and the Sulphur bottom, are seen in all seas, and in all latitudes:—cross the equator and go elsewhere. Hump-back whale

—is found usually on the coast of Chili and Peru, and New Holland, and up and down the coast of California, Lat. 40° South and Lat. 40° North, are plenty;—have been chased in Valparaiso and Sandwich Islands;—hardly worth catching,—the large ones have but 50 barrels—a common whale of the same size, 100 barrels—usually, 60 feet, some are 70 feet."

From same to same—July 26th, 1851.

"Your favor of the 28th ult. came to hand; contents duly noticed; and in reply, say, I have with pleasure made your 'grateful acknowledgments' to Capt. Howland, of Ship Citizen, for his 'kindness and attention,' as you directed.

Capt. H. says further as regards sperm whales staying for days under water, that in cruising for instance on or near the equator, round the Gallapagos, and westward also on the coast of Japan—these places are cited as celebrated haunts, where hundreds of ships are cruising near each other at the same time,—that not unfrequently no whales are found for several weeks, when all at once, as if by magic, the ground for hundreds of miles, will be found abounding with sperm whales; when the great work of slaughter simultaneously begins. They at last disappear, and suddenly and unexpectedly as they came. After the decks are cleared and oil stowed below decks, sail is again crowded on the ship; while cruising they often speak each other, and report the success they have had. It is then known that the whole fleet found whales about the same day, and lost them near the same time. I entirely agree with Capt. H. and others of great experience in their opinion as above; and what is very extraordinary, when the whales are first seen they are slow in their movements, and headed every point of the compass.

The sea elephant has never yet been seen out upon the open sea, either by their pursuers or whalers; they are first seen crawling up the beach, where they bring forth their young; and at other seasons to shed their coat.

They therefore must remain for months under the surface, or on the bottom; whether they carry with them a reservoir of compressed air to feed upon, or whether they die and are brought to life again, God only knows, *I do not.* The 'Notice to Whalemen' sent me I have furnished to owners and masters as they have called; still have a small supply on hand; happy to say they were most gratefully received.

The 'long looked for' Whale Chart (Series F) has at length arrived, (one dozen copies,) they are appreciated very highly by all intelligent men, especially owners and masters. A large supply is now or soon will be wanted for distribution."

From same to same.

October 20th, 1851.

"The Whale Chart is a precious jewel; it seems to have *waked* up the merchants and masters to the practical utility of your researches in their behalf; there is not, and cannot be but one opinion, and that highly favorable: it is sought for by all interested in whaling. * * * * * * * *

All our Arctic fleet, after passing Cape Horn, touch at the Sandwich Islands for recruits; hence you will notice, that on a course direct, they would pass over an immense region of almost barren ground.

But (as I tell them all) with the Whale Chart before them, they would have the united experience of more than fifty years, as to the *whereabouts*, and probable locality of whales.

And as sperm oil is by far the most valuable of their catchings, they would protract their passage but little, by steering through the thickest of the whales, as laid down upon the chart, till they reach the latitude of 4° or 5° South, then westward to meridian of the Sandwich Islands before crossing the equator; the loss of time would be nothing, when compared to the more than probable prospect of taking sperm oil.

While writing of sperm whales, whose history I like to dwell on, I would mention a rather mysterious, and to us, (old whalers) singular phenomenon, in regard to their remaining under water, or in any event, out of sight of those cruising for them, for days and weeks together; and when found—I mean the large males, (or bulls as they are called)—either alone, in shoals, or with the cows, their heads are lacerated and covered with scars, and deep old ulcers, evidently caused by fighting one another. This conclusion is obvious, from the regularity of the two lacerated lines, such as would be drawn by the two rows of teeth they have, and the distance apart of the old ulcers, just such as their teeth would be likely to inflict. This is remarked by all whalers, and corroborated by my long experience. If they fought on the surface, should we not find their wounds bleeding? If their wounds were recently inflicted, would they not have that appearance?

There is much doubt entertained here, whether the right whale, (or *Bowhead*,) as those are called, found in Japan and Ochotsk seas, in Anadir Bay, Behring's Straits and Arctic Circle, is the same as those found in Davis' Straits and Baffin's Bay.

Capt. Alyn, of ship "Rodman," on a recent voyage, while at the Sandwich Islands, saw a Capt. *Hasagen* who commanded the "Clemanteen," a Bremen whaler; said captain had been whaling two seasons in Japan and Ochotsk seas; he had also been two voyages whaling, this side, in Davis' Straits and Baffin's Bay; he noticed a marked difference about the head, and thought them a separate species of the right whale; the heads of the *Bowhead* whale of the Arctic region, being entirely smooth, having no protuberance or crown, in which barnacles are thickly and deeply imbedded, as are those found in Baffin's Bay, South Atlantic, and South Pacific.

Messrs. Perkins and Smith, are owners of ship "McLellan," of New London, now on her second voyage whaling in Baffin's Bay and vicinity. I have written those gentlemen to make the inquiry of Capt. Perkins or any leading officer that might be at hand, as to the different organization (if any) as above. They kindly replied to my note, by stating, that no means were at present attainable to gratify my curiosity, but they were expecting the "McLellan" home soon, when they would make the investigation sought, and again write me.

All the evidence I can give in regard to a water communication from Behring's Straits to Baffin's Bay side, is: that I have caught and eaten at the Aleutian Islands, and at Kamtschatka, the same halibut, codfish, herrings and salmon, that are caught from the waters that wash the coast of these New England States:—and that I have caught, or tried to catch, fish along the Pacific coast from Chiloe to Kamtschatka,—from thence along the western Pacific,—often at the islands,—at New Zealand, and at Van Dieman's Land,—and have never found either of the kinds of fish above mentioned.*

*I have understood that codfish are to be caught in great quantities at the island of Juan Fernandez. But Captain McKenzie thinks the fish caught in such quantities there are not cod, and that my informant was mistaken.—M. F. M.

What I have seen, therefore, I do profess to know and understand; and in my reminiscences west of Cape Horn, where I have spent (on board ship) thirty years of the best of my life, it will not, I trust, be deemed presumptuous, should I rely upon, and boast a little of, great experience in that region."

In this stage of my investigations into the habits of the whale, I have thought it best to give the foregoing letters without any comments of my own. They possess much interest and have a peculiar value. I quote them, not for the purpose of exciting discussion among naturalists, but for the purpose of eliciting further information from the whalemen themselves; hoping that these last will be induced to go more into detail, and give us all the information which they possess; and among such a number of close observers there is no doubt much to be elicited that is truly valuable. I need not add that naturalists would be thankful to any whaleman who will furnish them with a specimen of the *hair* with which we are informed by Captains Post and McKenzie that whales are covered.

It is proper to remark that I *infer* the figures of the whales (Plate X) were drawn by Mr. Conklin from recollection, and that I have others of the same species drawn by F. H. Smith, which I presume were also drawn from memory, and which resemble these so closely that there is no difficulty in recognizing the pictures of the different kind of whales as drawn by each.

Captain Smith makes this difference, however: His profile of the Russian or Polar whale has a protuberance in which the spout hole is inserted, whereas he represents the right whale as having no such feature.

Let us now return to the whale chart—letter F of the series.

By examining this chart it will, in its present state, serve to satisfy one at a glance that the favorite haunts of the sperm whale are about the equatorial; of the right, about the polar regions. That near the tropics is a sort of debatable ground, where the pasturage of the one overlaps the pasturage of the other. And that on either hand a straggler from the one herd is occasionally found far over within the borders of the other.

I have to request that whalemen when they come across these stragglers will observe them closely. Do they appear to be lost? what is their bodily condition, fat or lean? and what the contents of their stomach? Are the stragglers generally male or female, and what is there that is peculiar about them?

The whale chart (series F) which comprises a chart of the world, Mercator's projection of 10 degrees to an inch at the equator, and which extends from Lat. 79° 50′ N. to 68° South, shows three places where the sperm whale is in the habit of leaving the tropical regions and of resorting to higher latitudes. These places are in the South Atlantic where they have been found in large schools between the parallels of 30° and 35°; in the South Pacific, between the parallels of 35° and 60°;—and in the middle of the North Pacific as high up as 40°.

I account for their presence up in the North Pacific by the "Gulf Stream," which has its genesis in the Indian ocean, and its exodus in the China seas. It carries, high up into the North Pacific ocean, the warm waters and sea climate of the Tropics. And the sperm whale resorts there to enjoy it.

The sperm whale being found in the South Atlantic has suggested the inquiry as to the temperature of the waters there—can there be a warm current in that part of the ocean? If so, whence does it come?—from the intertropical regions of the Atlantic, or from the Indian ocean? or, is it a branch of the Lagullas current?

If it be the temperature of the water which invites the sperm whale into these extra-tropical regions of the South Atlantic, we may perhaps obtain from these dumb creatures an answer to the question: By what channel do the waters which the Lagullas current, and the ice-bearing current around Cape Horn, and the cold current from Baffin's bay, and the waters which the Mississippi river, the St. Lawrence, and all the great rivers of Europe, Africa, and America, bring into the Atlantic ocean—by what channel do these waters escape and preserve the level of that sea?

These currents bring into the Atlantic water more than enough to supply the waste of evaporation. The brine of the sea is not accumulating or concentrating in this ocean, and we therefore *know* that there must be somewhere in this ocean, either at the surface above or in the depths below, a current of large volume running from it. I have searched for it long and patiently. I have looked for it—feeling as certain of its existence as we do of a thing that has been seen and known to exist, and is lost—but in vain.

The components of sea water like the components of the atmosphere are every where the same. It is true that we find a little more salt in this place, and a little less in that; but this is attributable, not to the want of a general system of aqueous circulation in the terrestrial economy, but rather to local causes, such as an excess of precipitation, or an excess of evaporation, or the discharges of fresh water from rivers in the neighborhood. If the waters of the sea did not pass from one climate to another, and from one ocean to another, it would not be difficult to conceive, why, in the process of time, there should not be as great a difference in the waters in different parts of the great oceanic reservoir of the earth as there is in the waters of the Dead sea and the Mediterranean, or in the waters of any two seas, between which there is no communication.

The chemist analyzes the waters of the Mediterranean and of the Red sea, and detects the same components. Now, unless the waters of these two seas could intermingle,—and I have traced a current from the one to the neighborhood of the other—unless, I repeat, there were an intermingling between the waters of these two seas, what could preserve the same salts in the same quantities in each?

The Red sea, because it is riverless and rainless, receives no salts from the land on its shores. Whereas the rivers which empty into the Mediterranean have for ages been filtering "the salt of the earth," taking it up in solution from the soil, and bringing it down with their drainage into this sea.

Now unless nature had provided some means of process, by which the waters of these two seas should regularly intermingle with the waters of the ocean, and through the ocean, with each other, what would hinder the two seas from salting up their brine with different strength.

No doubt the harmonies of the sea are as beautiful and as sublime as the "music of the spheres." And to what agency therefore, if not to the agency of currents and the mobility of water, must we ascribe the permanent condition of sea water? for perhaps of all parts of creation that are both tangible and visible to us, the waters of the sea are most paramount and stable in their characteristics, proportions and constituents.

If nature had not provided a general system of circulation for the waters of the sea, what would prevent the waters of the Mediterranean for instance from absorbing salts and other constituents through its rivers, and

of accumulating them in quantities and proportions, which would possibly make a characteristic difference between sea water from the Mediterranean and sea water from the Red sea?

That the waters of remote seas do not permanently attain different degrees of saltness—that sea water like the air of heaven, come whence it may, is always the same—may of itself be taken as a proof, if no other evidence could be had, that there is a regular and constant passage, secret and invisible though it be, of the waters from one oceanic basin to another. At least in the present state of our information upon this subject, we infer that such is the case; and that it is owing to the agency of currents in the depths below and on the surface above, that the waters of one sea are not all brine, of another all fresh, and of another all ice.

Twice, perhaps thrice as much fresh water is discharged by the rivers of Europe, Africa and America, into the Atlantic, as is discharged by all other rivers into the Pacific. Twice, perhaps thrice as much fresh water is taken up from the Pacific as from the Atlantic by evaporation. Now, if the waters of these two oceans were never to intermingle—if the waters of the Pacific never found their way into the Atlantic, and if the Atlantic were never to send its waters to mingle with those of the Pacific ocean in its own basin, what would prevent the great water-sheds that are drained into the Atlantic from filling its basin up in the process of time, with fresh water? What, too, would prevent the Pacific, which gives more fresh water to the clouds than they restore to it again, from becoming first, a sea of brine, then finally a bed of salt?

Studying the habits of nature, so to speak, with regard to the air, and the sea, I have learned to conjecture that every drop of water now in the Pacific, has been at some former period in the Atlantic; and this conjecture, reason teaches me, is as plausible as is the supposition that every breath of air now in the northern hemisphere, has at some time or other, in following its appointed paths, coursed its round in the general system of circulation through the channels of the southern hemisphere.

Assuming these principles to be in conformity with the designs of nature, I have been induced to search for a current from the Atlantic ocean into the Pacific.

Taking its existence for granted, therefore, as I am disposed to do, it can be readily shown that this current does not have its exodus through the Arctic ocean; for in that case, the precipitation in that ocean being greater than the evaporation, the waters of the great rivers of northern Asia, Europe and America, being added to its own waters, would create a stream of immense volume and frightful rapidity through Behring's straits into the Pacific. Whereas, so far from this being the case, the reverse occurs.

The current through Behring's straits runs generally from, not into the Pacific. I have therefore looked to the South Atlantic;—to the space between the two stormy capes, as the only place in which this ex-Atlantic current could make its exodus. And if, after all this special and minute investigation;—if, after the most accurate and careful, and patient examination that has been made of Log-books here for some evidence of this current;—if, after the attention of navigators has been called to it, and they have exhausted all the means which human ingenuity has devised for detecting and measuring currents at sea, and have failed to discover one here;—if, after all this labor and research, it should so turn out when we go there with the water thermome-

ter, that the sea climate is not an extra-tropical one as its latitude indicates, that it is the inter-tropical temperature of its waters which tempts the sperm whales to gambol there in such multitudes—then the discovery of the fact that the sea water here is a little warmer, and that therefore there is a current running hither from the equator, should be regarded as one which is due to the information which the study of the habits of this animal has given us.

In the sperm whale region off the coast of Chili and Terra del Fuego, we have been taught to believe in the existence of a cold current. Assuming this cold current to be there;—that it is not crossed or divided by a warm current, the resort of the sperm whales there must be regarded as an anomaly in the habits of the creature.

These investigations as to the habits and places of resort of the whales, have taught me to regard sperm whales as much out of place in cold water, as the whalers themselves would regard out of place, a wilderness of howling monkeys of the Amazon among the Green Mountains of Vermont.

The following notice from this office to whalemen, has been published in the newspapers of the day.

Notice to Whalemen.

National Observatory,
Washington, May, 1851.

Captain Daniel McKensie, of New Bedford, and George Manning, of New York, have been engaged for a year or two in collecting materials for this office relating to the habits of the whale, &c.

These materials have been used here by Lieutenants Herndon and Leigh, and by P. Mid. Jackson, of the Navy, in making a Chart to show when and where our whalemen have searched for whales, when and where they have found them—with what abundance, and whether in schools or alone.

This chart divides the ocean into districts of 5° lat. by 5° long.; perpendicularly through each one of which districts, are 12 columns for the 12 months; and horizontally through each one of which districts are three lines; one to show the number of days that have been spent in each month in every district, and the two others show the number of days on which whales, sperm or right, have been seen. Thus:

A.

	85° W.		Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	
5° N.	Days of search.		125	11	2	7	72	90	155	148	183	138	112	94	80° W.
	No. of days Whales seen.	Sperm.	18	0	0	1	21	13	20	30	41	37	38	9	
		Right.	0	0	0	N.	0	0	0	0	0	0	0	0	
Equator.	Days of search.		53	81	108	180	138	97	157	179	160	189	139	81	Equator.
	No. of days Whales seen.	Sperm.	5	8	10	17	8	3	23	22	10	14	5	9	
		Right.	0	0	0	M.	0	0	0	0	0	0	0	0	
5° S.	Days of search.		45	111	70	56	56	50	91	125	119	95	94	97	5° S.
	No. of days Whales seen.	Sperm.	3	9	2	1	5	2	6	8	13	10	8	3	
		Right.	0	3	0	P.	0	0	0	0	0	0	0	0	
10° S.															10° S.

B.

	80° W.		Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	
40° S.	Days of search.		148	96	39	54	25	5	8	0	26	116	222	255	75° W.
	No. of days Whales seen.	Sperm.	2	3	0	16	2	0	0	0	1	4	10	0	
		Right.	27	7	1	Q.	2	0	0	0	7	21	76	105	
45° S.	Days of search.		48	58	16	8	3	0	6	0	0	5	4	22	
	No. of days Whales seen.	Sperm.	5	0	3	R.	0	0	0	0	0	0	0	1	
		Right.	5	1	0	0	0	0	0	0	0	0	0	10	
50° S.	85° W.														

The above is an extract from the Chart, which though partial and meagre, nevertheless affords information that I have thought might prove of some value to the great national interests which attach to the American whaling business.

It will appear from the above sample, that I have had examined the Log-books of whalers who altogether have spent 1,131 days in the district (N) between the equator and 5° N.—80° and 85° W., without ever having seen a right whale. In the district (M) that joins it, on the South, sperm whales have been seen in every month of the year, but less frequently in April, May, August, and October. This, too, is a place to which right whales never come; and it appears that the district (P) which joins this one immediately on the South, is much frequented by the sperm whale, but only now and then by a straggling right whale, in January.

If the information afforded by the great number of vessels, whose Logs have chanced to be examined for

these districts, be a fair sample of what the whole would show, as it is supposed to be, then it would appear altogether useless to look here for right whales.

In the sample marked B off the west coast of South America, between 40° and 50° South, 75° and 80° West, it appears that the upper district (Q) is not much frequented by the whalers in May, June, and July, nor by the whales in January, February, and March, except sperm, which are most abundant in March, April, and October. Whether it be a place of much resort for either kind in May, June, and July, we have not found Log-books enough to show.

It is almost of as much importance for whalemen to know where whales are not to be found, as to know where they are; for this is a case in which negative information is almost as valuable as that which is positive.

I have, therefore, selected from the Whale Chart those districts of the ocean in which most whales *have been* found in former years. Whether they have changed their places of resort, my information does not enable me to say.

But according to the Chart which is constructed for the whole ocean in the manner already explained, these are the places in which most whales *have been* found, and which it may be supposed now afford the best whaling grounds.

SPERM WHALING GROUND ABOUT THE EQUATOR.			RIGHT WHALING GROUND SOUTH PACIFIC.		
Months.	**Latitude.**	**Longitude.**	**Months.**	**Latitude.**	**Longitude.**
	° °	° °		° °	° °
May to Nov. inclusive,	0 to 5 N.	80 to 75 W.	Jan. Feb. and March, -	20 to 50 S.	45 to 50 E.
April to Dec. "	0 " 5 "	85 " 80 "	Sept. Oct. Nov. and Dec.,	30 " 40 "	55 " 60 "
Dec. to July, "	5S." 5 "	90 " 85 "	Oct. Nov. Dec., - - -	30 " 40 "	60 " 65 "
Dec. to March, "	0 " 5 "	90 " 95 "	Oct. Nov. Dec., - - -	30 " 40 "	65 " 80 "
February, - - - -	0 " 5 "	125 " 120 "	December and January, -	35 " 45 "	90 " 95 "
All the year, - - - -	0 " 5 S.	170 " 180 E.	July to Nov. inclusive -	35 " 40 "	115 " 120 "
All the year, - - - -	0 " 10 "	85 " 80 W.	Nov. and Dec. - - -	35 " 45 "	120 " 130 "
All the year, - - - -	5N." 5 "	95 " 90 "	January, - - - - -	45 " 50 "	160 " 170 "
All the year, - - - -	0 " 10 "	110 " 100 "	Dec.Jan.Feb.Mar.&April.	40 " 50 "	170E" 175W.
Aug. to Sept. inclusive,	0 " 5 "	115 " 110 "			
Nov. to March, "	0 " 5 "	120 " 115 "			
Dec. to April, "	0 " 5 "	125 " 120 "	NORTH	PACIFIC.	
Jan. to June, "	0 " 5 "	130 " 125 "			
Feb. to June, "	0 " 5 "	135 " 130 "	April and May, - - -	40 to 45N.	145 " 150 E.
January, - - - - -	0 " 5 "	145 " 140 "	July to Oct. inclusive, -	45 " 50 "	145 " 150 "
Dec. to Jan. - - - -	0 " 5 "	155 " 150 "	April and May, - - -	40 " 50 "	150 " 155 "
March to May, - - -	0 " 5 "	160 " 155 "	May to Sept. inclusive, -	45 " 55 "	155 " 165 "
Dec.Jan.Mar.June & Nov.	0 " 5 "	175 " 170 "	May to Sept. "	45 " 55 "	165 " 170 "
Dec. Jan. Feb. - -	10S."15 "	80 " 75 "	May to Sept. "	50 " 55 "	160W.165W.
July to Nov. inclusive,	10 " 15 "	85 " 80 "			and in Behr-
July to Feb. "	10 " 15 "	90 " 85 "			ing's Straits.
Nov. to June, "	10 " 15 "	85 " 80 "	May to Sept. "	50 " 60 "	155W.130W.
NORTH	PACIFIC.				
May, June, July, - -	25 to 30 N.	140 to 145 E.	SOUTH	ATLANTIC.	
May to Aug. inclusive,	25 " 30 "	170 " 165 W.			
April to Oct. "	30 " 35 "	145E"170 "	Aug. to Dec. inclusive, -	35 to 40 S.	25 to 20 W.
July to Aug. "	25 " 35 "	140 " 145 E.	Aug. to Dec. "	35 " 40 "	20 " 5 "
June to Oct. "	30 " 35 "	150W.170W.	Sept. to Dec. "	35 " 40 "	5W" 10E.

As to whether the right whales are to be found in the high northern latitudes in our winter, or in high southern latitudes in our summer, when the whalemen do not visit such latitudes, of course the Chart does not show. Thus, between 50° and 60° N., 130° and 155° W., we only know that right whales are abundant from May to September, inclusive; we know not as to the other months, because the night and cold there drive the whalemen from this part of the ocean, and we cannot say anything as to the numbers in which the fish resort there then. The Charts are, therefore, silent on the subject.

It is the same at the South, in its seasons: that is, when it is winter there the whalemen abandon the high latitudes, and seek their game in more genial climates.

But seeing the abundance of whales in the Greenland and Arctic seas in our summer season, and seeing that they have not been sought for in similar latitudes South, I invite the attention of whalemen to the subject of southern whaling in south summer time.

Below the parallel of 50° S:—indeed, with here and there an exception, I might say, that below the parallel of 45° S. the Whale Chart is a blank. It is very seldom that vessels go beyond the parallel of 55° S. The indications of the Chart are, that somewhere to the south of the parallels, and between the meridians as given below, whales are probably to be found in considerable numbers, if not in great quantities, viz:

Below	40° S.	from 25° West	to	10° East.	A
"	50° S.	" 45° East	"	60° "	B
"	45° S.	" 110° "	"	140° "	C*
"	50° S.	" 160° "	"	150° West	D

In view of all the information before me, I would suggest the following as a very inviting route or cruise for a vessel that finds herself on the Whaling Ground of the South Atlantic in our fall months.

She can cruise in the region A, of the last mentioned table; and from that, but still keeping well down to the South, pass rapidly on, unless she finds whales, to the region B.

A week or two here will satisfy her as to the prospect of whales. She may then enter the region C, where time might be spent in the search, crossing different parallels, and taking care to keep well to the South.

After having cruised and tried sufficiently in region C, the favorite region, the vessel may then "crack on" for region D; and when this region is explored, the season at the South will probably be over.

The N. W. are the prevailing winds of these latitudes, and therefore the programme of the route would be easy. Ending the search for the right whales at the South, and leaving the region D, for the equatorial cruising grounds, and entering these between 175° E. and 150° W., the route westward, and between 5° S. and 10° S., will be through good Sperm Whale grounds. These grounds commence between the meridians of 180° and 170° West, after crossing the parallel of 35° South, for just here, Sperm Whales resort in great numbers. Continue North between these meridians till you cross 10° South, for there is good sperm fishing all the way.

From 170° E. to 165° W., between the Line and 10° S., is capital sperm ground.

* This region is particularly attractive.

The vessel, therefore, reaching this ground between the meridians of 170° E. and 180° W., may tarry in it, tending westward as long as she has luck, taking care not to look North of the Line here for whales, for they are not to be found except as stragglers, or in occasional schools.

After crossing these grounds, which reach westward as far as 170° E., and East to America, she should carry on without stopping to look for whales until she crosses 20° N., between 165° W. and 175° E., which is again fine Sperm Ground. After passing west of 175° E., she will find good Sperm Ground between the parallels of 20° N. and 30° N., as far as 140° E.

Passing from these grounds, excellent right whale fishing will be found above the parallels of 50° N., between 135° W. and 160° W.; above 45° N., between 145° E. and 170° E; above 35° N., between 145° E. and 155° E., and up through into Behring's straits. There is good fishing upon these last mentioned right whale grounds from May to September, inclusive; I have not yet found the Log-book of any whaler that has cruised here at any other season of the year, and therefore my information as to the rest of the year is negative.

But there is reason afforded by the Chart for the opinion, that the right whales of the North Pacific ocean, seldom come to the South of the parallels named; and that, therefore, as a general rule, they remain somewhere to the North of the parallel of 35° all the year.

If this indication of the Chart be correct, and I see no reason to question it, it appears that this animal must have supplies of food all the year round, above 35° N.

I have reason to believe that temperature of the sea has much to do with the whale or the growth of its food: that the sperm whale delights in warm water, and the right whale in cold; and those whalemen who co-operate with me in collecting materials for the wind and Current Charts, and the Whale Chart belongs to the series, will therefore understand and appreciate the importance of keeping a *daily* record as to the temperature of air and water.

There is another point also to which I would call their attention, because by regarding it, it may prove of value to them, and that point is *deep sea soundings*.

It is conjectured that the sperm whale goes to the bottom of the sea for its food. What is the greatest depth to which it can go for this purpose, and are its places of resort *confined* to parts of the ocean that come within those depths?

Now, if owners would provide their ships, each with a few thousand fathoms of twine, and scraps of old iron or lead to serve as sounding weights, I am sure that the whalemen from the great degree of philosophical interest, which many of them manifest with regard to my researches, would, in calms, get deep-sea soundings for me. If the ocean were very deep, and the time could not be spared to haul up the line, it might, the length out being known by what is left, be cut; and as the line and sinker would cost but little, the expense to each ship would be but a trifle.

I take this occasion to say—because some of the whalemen have supposed it unnecessary to continue the abstracts when in sight of land—that it is important to have a complete abstract for every day they are at sea, that we may know whether they find fish or not, how plentifully, the force and direction of winds and currents,

the temperature of the air and water, and that we may glean information as to all other phenomena, which they are requested to note in the Abstract Log.

Plate XIII is a section taken from the whale chart of the world. It is a copy, and nearly a fac-simile, except that in some of the charts, the Right whale curves are colored blue, and the Sperm, red. Take the square marked A. as an illustration and explanation of the chart. Between the meridians of 45° and 50° W.—as between every fifth pair of meridians—are 12 columns for the 12 months; the first column on the left always standing for December, or the first Winter month, the next for January, and so on.

Between the parallels of 35° and 40° are 11 horizontal lines. Beginning always at the South and counting up towards the North, each of the first ten of these lines stands for 10 days, thus making the 10th stand for 100. The scale is then changed; the 11th line stands for 200; and the 12th on the parallel of Lat., for 300 days. See the figures in the margin.

Now by following the curve for the days, and the curve for the whales, Right and Sperm, for this square—it will be seen that during different years, whalers have spent in this square upwards of 100 days (125) searching for whales in the month of December; and that out of this time, they saw Right whales on 15 days—Sperm on 2; and that during each month they have fished and seen as follows, viz:

Days of Search.		No. of days on which were seen— Right Whales.	Sperm Whales.
In December,	125	15	2
January,	96	8	12
February,	150	5	10
March,	110	2	8
April,	78	0	5
May,	28	0	3
June,	12	0	0
July,	8	0	0
August,	28	0	0
September,	68	20	0
October,	90	25	8
November,	88	43	5

It appears, therefore, that from September to December inclusive, is the best time for whaling in this district of 5° square. In some of its neighboring districts, whalers have been more successful in other months, as a glance at the chart will show.

It is worthy of remark that the Sperm whale, according to the results of this chart, appears never to double the Cape of Good Hope. He doubles Cape Horn. Since this fish delights in warm water, shall we not expect to find off Cape Horn, an under current of warm water, heavier with its salts?

*Routes to and from Europe.**

The information contained under this heading relates to the best routes, under canvass, between New York and Europe.

The best average route, each way, as it regards the winds, independent of currents, is only indicated.

Upwards of thirty thousand observations on the winds in this part of the ocean alone, have been collated, compared and discussed for these routes.

The routes now indicated are the results of this mass of materials, and these routes are to be looked upon as the mean or average track of all the vessels engaged in making the voyages which have afforded these observations, supposing that each vessel under all circumstances and on every occasion, had made the most judicious courses.

My information is yet quite meager in many portions of this part of the ocean, and the present routes should be regarded, not as fixed and final determinations; they are rather approximations.

Though they be approximations to those routes which further investigations, based on more ample materials, may establish as the best routes, their importance will no doubt be readily appreciated, when it is considered that the average per centum of calms, head and fair winds, is stated for each district of 5° square of ocean through which the vessel is recommended to pass; and that they are stated in the tables and exhibited on the charts in such a manner, that the navigator who pursues these routes and consults the authorities before him, will be freed from all doubt and perplexity as to which tack to take when the wind comes out *dead* ahead.

Upon a right decision in such cases often depends the success of the voyage, as to time.

I have now before me the Log-books of two vessels, which afford a case in point; they were bound to Europe—were together and had accomplished more than half the voyage; the wind came out ahead; one stood off to the northward on the starboard tack, the other to the southward on the opposite tack; one was right and the other wrong, for in consequence, one got into port 10 days before the other.

In such cases, those who pursue these routes with the Pilot Charts on board, would be left in no doubt as to the tack having the greatest number of chances in its favor.

Permit me to call attention to a very remarkable part of the ocean through which these tracks pass. It is about 45° N. and 50° W. The water here is permanently cold, so cold that the water thermometer is sometimes found within the distance of a few miles to fall 40° of Fahrenheit, and I notice in many Log-books the remark, "water, colored."

The spot is also remarkable for its fogs and its disturbed atmospherical conditions. If a vessel could be sent to examine into it, important service might be rendered to navigation, by showing how, when the heavenly bodies are obscured, the mariner may determine the position of his ship by dipping his thermometer into the water; or the examination might lead to other results not less important. It is probably the centre of great atmospherical disturbances.

*Letter to Sec. Navy, Jan. 1, 1850.

There is said to be somewhere along these routes, a rock just awash and not known to any chart. The doubtful existence of such a danger is always perplexing and harassing to navigators: not knowing its exact position they have to turn far aside out of the way, to be sure of avoiding it. The rock is small—only a few feet across—with bold water up to it. And because it is said to be in a part of the ocean that is so much frequented as is this, it is a matter of great importance to the mariner that all doubts as to its existence and locality should be removed. I have the reports of navigators who have seen it, and who have passed so close to it that they might have thrown a biscuit upon it. But its position is vaguely described.

I have received the following "Notice to Mariners."

"On the 2d Dec., (1849,) the ship 'Marmion,' Capt. Freeman, from Liverpool, when in Long. 69° 29′ W., "Lat. 41° 05′ to 41° 01′, got in between two tide rips, which broke. Capt. F. had been sounding 21 fathoms, "and on steering S. by E. to S. by W. found as little as seven fathoms, which of course would be dangerous "in blowing weather. * * *

G. W. BLUNT."

And in addition the following has been published touching the same:

NATIONAL OBSERVATORY, *February 10th*, 1851.

SIR:—Captain R. F. Hartshorn of the ship "E. Z.," reports in his "Abstract Log" kept for this office, the discovery of a shoal in a much frequented part of the ocean, viz: near Nantucket shoals and directly in the route hence to Europe.

Extract from his Log from Liverpool to New York, last July—

"N. B.—During the two days, the 20th and 21st July, I was beating between Lat. 41° 10′ to 41°, and Long. 69° to 69° 40′; the fog very thick; several times I shoaled the water suddenly from 20 fathoms to 8 and 7—steering S. S. W. to S. by W. I am certain there must be a very shoal spot in the neighborhood of 69° 30′, or 69° 35′, and Lat. 41° to 41° 08′. I had the lead constantly going during the 56 hours, and the soundings differed very materially from Blunt's Charts soundings.

"I have sounded a good deal about Nantucket shoals during the last 8 years, and find the depths of water in the same places have changed more than I could have possibly believed; but it is a positive fact."

The place of this shoal is 6 or 8 miles to the southward and eastward of Davis' Bank, discovered by the Coast Survey in 1846. It is possible that this may be the shoal reported by Captain Hartshorn; but doubt as to the existence of dangers in such a frequented part of the ocean, cannot be harmlessly tolerated. I, therefore, would recommend a careful examination of the locality.

Respectfully, &c.

M. F. MAURY.

HON. WM. A. GRAHAM,

Secretary of the Navy.

These reports as to danger in this part of the ocean, led to an examination of this locality by the Coast Survey. The result was, thanks to Capt's. Freeman and Hartshorn, the discovery of three shoals.—Vide Coast Survey Chart: "Davis' South Shoal and other Dangers," 1852.

The best average routes to and fro, between New York, Cape Clear, and the English Channel.

These routes are calculated from the Pilot Chart also; and they represent each for its month, the best track *on the average*, which a vessel can make.

The navigator who intends to follow any one of these routes should lay it down on his chart from the table; and when he gets thrown off of it by the winds and currents as he often will, he should then, instead of turning out of his way to get back to it, recollect that if a special route were now calculated for him from his position, it probably would not touch the projected route at all. He, therefore, is in a new position, and must consult his pilot chart as to future courses and route. In recommending these routes, and in speaking of them, I wish navigators to understand and bear it in mind *always*, that I am speaking from the information before me, which is sometimes imperfect and often deficient. When full and complete, it may modify present conclusions; present conclusions, therefore, must be regarded only as approximations.

If every vessel, whose log between this and Europe has afforded materials for the Pilot Chart, had always taken the most judicious course; and when she was headed off, if she had in every instance taken that tack which was really the best, and then if a line had been drawn to represent on the chart the average or mean track of all those vessels for January, February, March or April, and the other months, then that line would be represented by the route as given in the tables for that month.

In other words, the vessels that shall pursue the routes here given, will pursue exactly that course which the experience of all has shown to be the best on *the average*.

By consulting the Pilot Chart, or the column "Total No. of Observations," in the table of Routes, it will be observed that for the months for which the routes are given for European traders, I have not observations enough to the North of 45° N., and West of 45° W., to enable me to speak of the advantages or disadvantages of making that part of the ocean a greater thoroughfare than it is.

Take the route *from* New York in March for illustration: It will be seen by the table that the course recommended from longitude 55° to 50°, is East, and that the winds are from E. on *the average* 1.9 per cent. of the time, and that a vessel in steering E. there, would be headed off from her course by slant winds from the northward 2.8 times, and by slant winds from the southward 15.9 times in the hundred—and that these proportions are derived from the records of 108 vessels between these meridians in that month, or which is the same by 108 observations there, during the month of March of different years.

The South, therefore, is the windward side then and there; therefore these facts thus presented will leave the navigator when he comes to be headed off in that part of his route, in no doubt as to which tack to go upon: with the wind directly ahead or East, he should stand to the southward or to windward, because the probabilities of the wind's coming out from that quarter are greater than they are that it will come from the northward.

Again, from the meridian of 35° to 30° W., the best average course is E. N. E.—1.3 per cent. of the winds are *dead* ahead, and 19 are slant from the northward against 4.3 from the other side. Here then it is shown from the records of 80 vessels, that the northward is the windward side.

I have the records of two vessels which were together in this part of the ocean, on their way to Europe;

they had kept together so far on their way; they sailed alike: when they arrived here, the wind came out ahead —one went off on the larboard and the other on the starboard tack; the latter arrived in port ten days before the other. With the Pilot Chart on board, it would have been impossible for the other vessel so to have mistaken the chances in favor of her proper course. Capt. Hartzhorn, of the "E. Z." informs me, that on his last voyage in 1852, from Liverpool to New York, he made these charts his guide; that he made the most remarkable passage of the season, (19 days,) and that vessels which sailed about the same time he did, did not arrive for twenty days and more after he did. He attributed his success to the lights which the experience of others, expressed by these charts, afforded him.

I have not calculated the track beyond 10° W. off Cape Clear for the Liverpool track; nor beyond 5° W. for the English Channel, because beyond these meridians, the best course to steer is indicated by the land and the winds that happen to prevail.

ROUTES BETWEEN NEW YORK AND EUROPE.

Best average routes between New York and Long. 10° *W., for vessels bound to and from Liverpool; also between New York and Long.* 5° *W., for vessels bound in or out of the English Channel.*

NEW YORK TO EUROPE.—JANUARY.

Latitude	Long'de	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observations.	
			True.	Per Cent	Average.	Head.	SLANTS FROM		Fair.	Calms.		
							N'd.	S'd.				
40°28′	74°00′	to										
40 28	70 00	E.	182	6.2	193	6.2	6.0	5.0	82.8	2.1	97	
42 02	65 00	E. N. E.	245	10.4	271	2.8	5.6	*w* 13.3	78.3	3.6	143	
43 33	60 00	E. N. E.	238	20.8	287	8.0	12.8	12.8	66.4	3.2	64	
43 33	55 00*d*	E.	217	4.2	226	0.0	*w* 11.0	4.4	84.6	4.4	94	
45 03	50 00	E. N. E.	233	14.4	266	4.8	*w* 13.2	8.4	73.6	8.5	89	
45 03	45 00	E.	212	11.4	236	0.0	14.3	14.3	71.4	0.0	7	
45 28	40 00*d*	E.	212	6.8	226	0.0	3.1	*w* 18.6	78.3	0.0	32	
45 27	35 00	E.	212	5.1	223	1.5	3.0	4.5	91.0	9.2	71	
46 30	30 00	E. N. E.	227	8.5	246	2.2	9.9	9.9	78.0	2.1	94	
47 55	25 00*d*	E. N. E.	221	5.6	233	0.0	4.8	*w* 13.2	82.0	7.0	92	
47 55	20 00	E.	201	8.1	217	1.5	9.0	*w* 12.0	77.5	3.1	67	
49 17	15 00	E. N. E.	214	2.2	219	0.0	1.4	*w* 8.4	90.2	2.8	74	
50 00	12 20	E. N. E.	113	6.3	120	2.1	4.2	4.2	89.5	0.0	43	} To
50 38	10 00	E. N. E.	98	15.1	112	5.8	*w* 13.6	2.9	77.7	1.9	105	} Liverpool.
			2825		3075							
49 17	10 00	E.	196	8.0	212	4.2	*w* 4.2	0.0	91.6	0.0	43	} To
49 36	5 00	E. ½ N.	196	24.9	245	8.3	0.0	*w* 41.5	50.2	0.0	12	} Channel.
			3006		3300							

NEW YORK TO EUROPE—FEBRUARY.

Latitude.	Longitude.	Courses.	DISTANCES. True.	DISTANCES. Per Cent.	DISTANCES. Average.	WINDS; PER CENT. Head.	SLANTS FROM N'd.	SLANTS FROM S'd.	Fair.	Calms	Total No. observ'ns.	
From 40°27′	74°00′to											
40 45	70 00	*E. ½ N.	182	7.7	196	1.0	8.7	w 10.5	79.8	1.9	106	
41 42	65 00	E.by N. ½ N.	233	8.2	252	3.4	w 8.5	3.4	84.7	6.6	62	
43 13	60 00	E. N. E	238	5.7	251	0.0	w 12.0	8.4	79.6	0.0	84	
44 42	55 00	E. N. E.	234	10.8	259	2.2	11.0	11.0	75.8	7.8	96	
44 42	50 00*d*	E.	213	9.0	232	3.3	w 12.1	3.3	81.3	2.3	88	
44 42	45 00	F.	213	7.4	228	0.0	w 13.0	8.0	79.0	2.9	105	
45 00	40 00	E. ½ N.	212	5.9	229	2.8	1.4	w 2.8	93.0	4.4	70	
46 26	35 00	E. N. E.	225	6.1	235	0.0	3.2	w 19.2	77.6	3.1	65	
47 50	30 00	E. N. E.	221	7.8	239	1.0	7.0	w 13.0	79.0	4.9	106	
49 13	25 00	E. N. E.	217	3.6	225	0.9	2.7	w 4.5	91.9	4.3	111	
49 13	20 00*d*	E.	197	10.3	216	3.0	8.0	8.0	81.0	4.0	103	
50 00	15 00	E.by N. ¼ N.	200	8.5	217	4.2	4.2	w 5.6	36.0	1.4	69	
50 50	10 00	E.by N. ¼ N.	196	11.2	217	3.6	5.4	w 16.2	74.8	3.5	118	To Liverp'l
			2,781		2,996							
49 30	10 00	E. ¾ S.	200	16.7	233	5.7	w 22.8	w 7.6	63.9	1.9	52	To Channel
49 30	5 00	E.	195	9.9	214	0.0	16.6	16.6	66.8	0.0	6	
			2,980		3,226							

Average sailing distance to 10° W. by this route to Liverpool 2,996 miles, for 215 of which the winds on the average, are *dead* ahead.

Ditto—to 5° ditto English Channel, for 246 of which the winds on the average, are *dead* ahead.

*NOTE.—Nantucket shoals are in the way of an E. N. E. course, which would be the best.

NEW YORK TO EUROPE—MARCH.

Latitude.	Longitude.	Courses.	DISTANCES. True.	DISTANCES. Per Cent.	DISTANCES. Average.	WINDS; PER CENT. Head.	SLANTS FROM N'd.	SLANTS FROM S'd.	Fair.	Calms.	Total No. observ'ns.	
40°27′	74°00′to											
40 27	70 00	E.	182	12.4	205	6.2	2.8	w 6.9	84.1	4.1	151	
40 00	65 00	E. N. E.	245	7.2	263	7.2	7.1	w 15.8	69.9	1.4	206	
42 45	62 30	E. N. E.	119	13.1	134	2.5	13.2	w 15.0	69.3	4.1	126	
42 00	60 00*d*	E. S. E.	119	13.7	135	4.2	13.3	13.0	69.5			
43 31	55 00	E. N. E.	238	13.2	269	9.6	7.1	w 15.1	68.2	5.3	118	
43 31	50 00	E.	217	7.9	234	1.9	2.8	w 15.9	79.4	0.9	108	
43 31	45 00	E.	217	9.4	238	1.7	w 10.3	8.5	79.5	2.5	121	
43 31	40 00	E.	217	3.7	225	1.6	2.1	3.2	93.1	5.0	200	
43 31	35 00	E.	217	7.6	234	0.0	2.9	7.6	89.5	4.8	109	
45 00	30 00	E. N. E.	233	4.3	243	1.3	w 19.0	4.3	75.4	3.9	80	
46 27	25 00*d*	E. N. E.	226	8.4	245	4.4	4.4	1.1	90.1	1.1	90	
46 27	20 00	E.	206	3.2	212	0.0	w 7.0	2.2	90.8	2.2	90	
47 52	15 00	E. N. E.	221	6.7	236	0.0	w 12.0	6.3	81.7	0.0	74	
50 00	11 45	N. E.	181	5.4	191	0.0	4.0	w 12.0	84.0	0.0	67	
50 44	10 00	N. E. by E.	81	10.8	90	5.4	6.0	w 8.4	80.2	3.5	116	To Liverp'l
			2,919		3,154							
50 00	10 00	E.	67	11.8	75	3.0	9.0	9.0	79.0	0.0	67	To Channel.
49 40	5 00	E. ½ S.	194	10.0	213	17.0	25.0	8.3	49.7	0.0	12	
			3,099		3,352							

NEW YORK TO EUROPE—APRIL.

Latitude.	Longitude.	Courses.	DISTANCES. True.	DISTANCES. Per Cent.	DISTANCES. Average.	WINDS; PER CENT. Head.	WINDS; PER CENT. Slants from N'd.	WINDS; PER CENT. Slants from S'd.	WINDS; PER CENT. Fair.	WINDS; PER CENT. Calms	Total No. observ'ns.	
40°27′	74°00′to											
40 27	70 00	E.	182	9.2	199	3.0	9.6	*w* 11.4	76.0	7.1	180	
42 00	65 00*d*	E. N. E.	244	12.3	274	3.2	8.3	*w* 11.1	77.4	2.5	161	
42 00	60 00	E.	223	12.7	251	5.2	7.8	*w* 9.1	77.9	7.3	88	
43 31	55 00	E. N. E.	237	7.9	256	2.4	6.4	5.7	85.5	4.1	126	
45 00	50 00	E. N. E.	233	5.0	244	0.0	*w* 9.9	*w* 7 2	82.9	10.1	120	
46 21	45 00*d*	E. N. E.	226	3.3	233	0.0	0.0	8.3	91.7	0.0	12	
46 27	40 00	E.	207	6.6	320	0.0	*w* 5.5	*w* 16.5	78.0	5.6	19	
46 27	35 00	E.	207	5.5	218	2.5	5.0	0.0	92.5	7.6	42	
46 27	30 00	E.	207	10.1	228	0.0	8.8	*w* 20.9	70.3	5.5	92	
47 52	25 00	E. N. E.	221	15.6	255	5.2	11.8	*w* 16.3	66.7	7.4	145	
49 14	20 00*d*	E. N. E.	215	12.9	242	4.2	6.7	*w* 10.9	78.2	5.9	125	
49 14	15 00	E.	196	8.8	213	3.6	*w* 13.2	3.6	79.6	7.5	86	
49 14	10 00	E.	196	4.6	205	1.1	1.1	*w* 7.7	90.1	0.0	89	
49 30	5 00	E. ½ N.	196	20.9	237	5.5	11.0	*w* 33.0	50.5	5.6	12	To Channel.
			2990		3375							
50 00	13 06	E. N. E.	79	4.0	82	1.1	4.4	5.5	89.0	0.0	89	To Liverpool.
Cape Clear	10 00	E. N. E.	130	3.6	135	0.0	3.6	3.6	92.8	0.0	80	
			2807		3150							

NEW YORK TO EUROPE—MAY.

Latitude.	Longitude.	Course.	DISTANCES. Direct.	DISTANCES. Per Cent.	DISTANCES. True.	WINDS; PER CENT. Head.	WINDS; PER CENT. North.	WINDS; PER CENT. South.	WINDS; PER CENT. Fair.	WINDS; PER CENT. Calms.	Total No. observ'ns.
Sandy	Hook to										
40°27′	74°00′										
42 00	70 00	E. ¾ S.	185	14.4	211	5.4	9.1	7.7	77.8	4.0	235
41 34	65 00	E. N. E.	246	10.2	271	2.7	11.0	6.8	79.5	7.3	281
43 06	60 00	E. N. E.	240	10.4	265	1.2	18.2	7.8	62.8	3.9	189
44 36	55 00	E. N. E.	234	8.8	254	1.2	4 3	11.0	83.5	3.0	170
44 36	50 00	E.	214	11.5	238	3.9	8.5	8.5	79.1	3.9	160
44 36	45 00	E.	214	7.3	229	2.2	7.6	6.0	84.2	4.8	195
44 36	40 00	E.	214	5.6	226	1.1	6.8	5.1	87.0	2.9	180
45 00	35 00	E. ½ N.	215	4.3	224	0.0	5.3	10.1	84.6	1.5	136
45 00	30 00	E.	212	4.8	222	0.7	7.8	4.3	87.2	4.8	132
45 00	25 00	E.	212	5.1	223	0.8	6.4	4.0	88.8	5.6	131
48 25	20 00	N. E.	290	9.6	318	3.0	9.0	9.0	79.0	3.0	137
48 25	15 00	E.	198	11.5	220	2.9	10.9	10.2	76.0	3.6	142
48 25	10 00	E.	198	16.8	231	4.8	21.6	10.4	63.2	3.2	129
To Channel.		E. N. E.	210	16.8	245	2.8	11.3	33.6	52.3	5.5	38
			3082		3377						
50 16	15 00	E. N. E.	212	16.4	246		8.7	8.7	75.3	3.6	142
To Liverpool.	10 00	E. N. E.	194	14.0	221		4.4	13.2	79.1	1.1	96
			2882		3148						

NEW YORK TO EUROPE—JUNE.

Latitude.	Longitude.	Course.	DISTANCE. Direct.	Per Cent.	True.	WINDS; PER CENT. Head.	North.	South.	Fair.	Calms.	Total No. observ'ns.
Sandy	Hook to										
40°08′	73°00′	E. S. E.	50	9.7	55	1.7	11.0	9.2	78.1		
41 13	70 00	E. N. E.	170	8.7	185	1.8	4.8	10.9	82.5	2.7	232
42 45	65 00	E. N. E.	241	8.5	261	1.8	3.5	3.9	90.8	3.5	235
42 45	60 00	E.	220	10.9	244	4.5	8.0	4.5	83.0	3.8	216
44 15	55 00	E. N. E.	236	8.5	256	3.3	3.8	7.1	85.8	1.1	184
45 43	50 00	E. N. E.	230	5.1	242	0.5	5.8	8.2	85.5	3.1	202
47 10	45 00	E. N. E.	224	5.9	237	2.3	0.0	6.8	90.0	0.0	44
48 33	40 00	E. N. E.	217	4.8	227	1.4	0.9	7.0	91.6	9.9	78
49 54	35 00	E. N. E.	212	10.7	234	3.1	5.0	11.9	80.0	3.1	165
51 13	30 00	E. N. E.	207	2.0	211	4.0	0.0	2.0	94.9	0.0	47
51 13	25 00	E.	188	0.8	189	0.0	9.0	2.0	98.0	6.1	52
51 13	20 00	E.	188	2.2	192	0.0	0.0	6.9	93.1	2.3	44
51 00	15 00	E. ½ S.	190	15.4	218	7.2	6.0	4.7	82.1	0.0	82
50 40	10 00	E. ½ S.	194	10.0	214	4.9	13.3	15.4	66.4	5.6	150
To Channel.			209	5.1	219	3.9	18.2	1.3	76.6	0.0	78
			2976		3184						

According to the Charts, this is the best track yet developed, and ought to give the shortest passages.

NEW YORK TO EUROPE—JULY.

Latitude.	Longitude.	Course.	DISTANCES. Direct.	Per Ct.	True.	WINDS; PER CENT. Head.	North.	South.	Fair.	Calms	Total No. observations.	
40°27′	74°00′ to											
40 27	70 00	E.	182	12.0	204	3.6	7.2	5.1	84.1	4.2	322	Calms.
42 00	65 00	E. N. E.	246	5.0	260	3.0	7.0	9.1	89.9	8.7	414	Calms.
43 30	60 55	E. N. E.	237	4.2	247	0.9	3.3	4.8	91.0	8.4	350	
43 30	55 00	E.	218	10.3	240	4.4	5.6	8.0	82.0	5.6	263	
44 59	50 00	E. N. E.	233	5.9	244	0.4	8.8	7.6	83.2	5.4	236	
44 59	45 00 d	E.	212	12.6	238	4.4	8.1	8.1	79.4	8.1	173	
45 40	40 00	E. by N.	214	8 0	231	1.0	8.0	3 0	88.0	4.0	103	
47 06	35 00	E. N. E.	224	3.3	231	0.0	2.2	11.0	86.8	4.6	95	
47 06	30 00	E.	204	5.9	216	1.1	10.6	4.1	84.2	3.2	77	
47 06	25 00	E.	204	9.0	222	2.1	10.6	8.2	79.1	6.5	100	
48 29	20 00	E. N. E.	218	8.8	237	4.2	2.1	6.3	87.4	9.4	105	
49 50	15 00	E. N. E.	213	8.5	231	2.5	13.2	3.3	81.0	2.5	125	Liver'pl.
50 30	10 00	To Li'rpool.	195	13.4	220	5.7	5.6	9.1	79.6	4.5	92	
			2800		3021							
48 29	15 00	E.	198	5.8	209	2.5	5.8	0.8	90.9	2.5	125	
48 29	10 00	E.	198	17.8	234	6.5	17.5	3.2	72.8	2.2	94	Channel
49 00	To Channel	E. N. E.	213	12.8	240	0.0	28.0	8.0	64.0	0.0	24	

NEW YORK TO EUROPE—AUGUST.

Latitude.	Longitude.	Course.	DISTANCES. Direct.	Per. Ct.	True.	WINDS; PER CENT. Head.	North.	South.	Fair.	Calms.	Total No. observ'ns.	
40°27′ d	74°00′ to											
40 00	70 00	E. ¾ S.	186	13.0	209	3.0	9.5	18.0	69.5	6.0	194	
39 12 d	67 30	E. S. E.	125	8.7	135	3.1	2.9	10.7	83.3	3.6	229	
39 12	65 00	E.	116	6.6	123	1.6	17.0	7.1	74.3			
39 12	62 30	E.	116	8 0	125	3.0	6.5	5.5	85.0	4.3	193	
40 00	60 00	E. N. E.	125	7.6	134	2.0	9.5	5.0	83.5			
41 34	55 00	E. N. E.	246	7.1	263	7.1	7.0	8.4	77.5	6.8	157	
43 06	50 00	E. N. E.	241	11.1	268	3.0	6.5	11.0	79.5	6.5	213	
44 36	45 00	E. N. E.	235	14.3	268	4.8	12.0	12.6	70.6	3.7	166	
45 00	44 26	N. E.	34	9.4	37	2.8	4.5	11.2	81.5	5.0	147	
48 08	40 00	N. E.	260	7.	279	0.0	11.4	12.6	76.0	7.9	123	
48 00	35 00	E.	201	8.2	217	2.4	7.2	7.2	83.2	9.4	129	
48 00	30 00	E.	201	8.0	217	3.0	4.0	5.0	88.0	2.9	106	
48 00	25 00	E.	201	3.0	207	0.0	5.0	6.0	89.0	1.1	92	
48 00	20 00	E.	201	8.4	218	3.0	9.0	1.5	86.5	7.8	69	
48 00	15 00	E.	201	3 0	207	0.0	8.0	2.0	90.0	4.2	100	
49 22	10 00	E. N. E.	214	3.7	221	0.8	11.2	0.0	88.0	3.2	130	Liverpool
49 30	5 00	E.	195	5.0	205	0.0	5.1	8.4	86.0	0.0	36	Channel.
			3098		3333							

NEW YORK TO EUROPE—SEPTEMBER.

Latitude.	Longitude.	Course.	DISTANCES. True.	Per Ct.	Average.	WINDS; PER CENT. Head.	North.	South.	Fair.	Calms.	Total No. observ'ns.	
40°27′	74°00′ to											
40 00	72 35	E. S. E.	71	5.4	75	0.0	9.9	5.4	84.7	4.5	115	
40 49	70 00	E. N. E.	128	15.3	147	0.9	30.6	9.0	59.5			
40 49	65 00	E.	227	10.4	250	4.2	9.0	3.6	83.2	5.3	178	
40 49	60 00	E.	227	15.5	261	6.3	13.3	4.9	75.5	5.3	159	
42 22	55 00	E. N. E.	243	5.6	256	0.0	13.8	5.4	80.2	3.7	167	
42 22	50 00	E.	222	16.3	257	6 0	14.4	9.6	70.0	6.2	172	
43 53	45 00	E. N. E.	237	15.0	272	4.9	11.2	14.0	69.9	5.8	147	
45 22	40 00	E. N. E.	232	9.8	255	4.2	8.4	4.2	83.2	2.2	138	
46 48	35 00	E. N. E.	225	8.9	245	2.6	9.1	7.8	80.5	1.3	78	Liverpool.
48 12	30 00	E. N. E.	220	4.7	229	1.2	6.3	5.1	87.4	6.2	85	
49 35	25 00	E. N. E.	213	4.2	222	0.0	9.0	5.0	86.0	8.0	109	
49 35	20 00	E.	192	12.2	216	3.6	11.7	15.3	69.4	0.9	111	
50 33	15 00	E. by N.	201	7.6	216	1.8	3.6	19.2	75.4	1.8	64	
50 33	10 00	E.	191	12.8	213	3.3	7.7	17.6	71.4	1.0	96	
			2830		3114							
45 22	35 00	E.	211	9.9	232	3.9	5.2	6.5	84.4	1.3	78	To Channel.
45 22	30 00	E.	211	5.3	222	1.3	2.5	8.8	87.4	6.2	85	
46 48	25 00	E. N. E.	225	4.2	234	0.0	9.0	5.0	86.0	8.0	109	
46 48	20 00	E.	205	12.2	230	3.6	11.7	9.0	75.7	0.9	111	
48 12	15 00	E. N. E.	220	11.4	245	3.6	2.4	9.6	84.4	1.2	81	
48 12	10 00	E.	200	14.8	230	3.6	21.6	5.4	69.4	1.8	57	
49 34	5 00	E. N. E.	213	15.0	245	0.0	10.0	40.0	50.0	0.0	20	

EUROPE TO NEW YORK—JANUARY.

Latitude.	Longitude.	Courses.	DISTANCES. True.	Per Ct.	Average.	WINDS; PER CENT. Head.	SLANTS FROM. N'd.	S'd.	Fair.	Calms	Total No. observ'ns.	
49°30′	5°00′ to											
49 30	10 00	W.	192	0.0	192	0.0	0.0	0.0	100.0	0.0	12	From Long.
49 30	15 00 *d*	W.	192	30.2	250	12.6	16.8	16.8	53.8	0.0	43	5° W.
50 40	10 00											From Long.
49 30	15 00 *d*	W. by S. ¾ S.	202	36.1	275	16.5	15.5	17.5	50.5	1.9	105	10° W.
48 08	20 00	W. S. W.	213	37.1	293	14.0	*w* 30.8	23.8	31.4	2.8	74	
46 45	25 00	W. S. W.	219	24.0	272	9.0	*w* 22.5	7.5	61.0	3.1	67	
45 18	30 00	W. S. W.	226	29.3	292	10.8	18.0	*w* 24.0	47.2	7.0	92	
45 18	35 00	W.	211	22.7	259	6.6	15.5	*w* 20.9	57.0	2.1	91	
45 18	40 00	W.	211	28.8	270	9.0	12.0	*w* 28.5	50.5	9.2	71	
43 49	45 00	W. S. W.	232	18.9	276	5.5	*w* 18.7	16.5	59.3	6.8	78	
43 49	50 00 *d*	W.	215	19.6	256	4.4	*w* 20.9	13.2	61.5	0.0	91	
42 19	55 00	W. S. W.	237	17.0	277	3.6	13.2	*w* 19.2	64.0	8.5	89	
40 46	60 00	W. S. W.	244	22.1	298	5.5	*w* 25.3	15.7	53.5	4.4	94	
40 46	65 00	W.	225	16.3	261	6.4	*w* 14.8	12.8	66.0	3.2	64	
40 46	70 00 *d*	W.	225	26.8	285	9.1	*w* 21.0	16.7	53.2	3.6	143	
40 27	74 00 *d*	W. ¼ S.	183	24.4	226	9.0	*w* 23.0	11.0	57.0	2.1	97	
			2843		3,540							

Average sailing distance from 5° W. by this route, 3,707 miles—and from 10° W. coming out of Liverpool, 3,540. The aggregate of adverse winds expressed in their equivalents of *winds dead ahead*, give 697 miles from Liverpool and 687 from the Channel, for the average number of miles to be overcome by a dead beat during the voyage. It will be observed that the most difficult parts of the route, are between Longitudes 15° and 20°; 25° and 30°; and 35° and 40° W.; and that calms are most prevalent between Longitude 25° and 30°, 35° and 45°, and between 50° and 55° W.

EUROPE TO NEW YORK—FEBRUARY.

Latitude.	Longitude.	Course.	DISTANCES. True.	Per Ct.	Average.	WINDS; PER CENT. Head.	SLANTS FROM N'd.	S'd.	Fair.	Calms.	Total No. observ'ns.
49°00′	*d* 10°00′ to										
47 38	15 00	W. S. W.	216	9.9	237	1.9	*w* 20.9	0.0	77.2	1.9	52
47 38	20 00	W.	202	18.8	239	5.6	11.2	*w* 19.6	63.6	1.4	69
47 38	25 00	W.	202	16.6	235	4.0	15.0	*w* 21.0	60	4.0	103
47 38	30 00	W.	202	24.8	242	6.3	17.2	*w* 25.4	51.1	4.3	111
46 12	35 00	W. S. W.	225	22.2	275	4.0	*w* 27.0	24.0	45.0	4.9	106
46 12	40 00	W.	208	29.4	269	11.2	12.8	*w* 19.2	56.8	3.1	65
46 12	45 00	W	208	17.1	244	3.0	16.5	*w* 22.8	57.7	1.5	66
44 44	50 00 *d*	W. S. W.	230	5.5	242	0.0	9.1	*w* 27.3	63.6	9.0	12
44 44	55 00	W.	213	23.9	264	8.8	*w* 22.0	16.5	52.7	2.3	88
43 15	60 00	W. S. W.	234	16.7	275	4.4	*w* 25.3	7.7	62.6	7.8	96
41 44	65 00 *d*	W. S. W.	239	20.9	288	6.0	*w* 31.2	8.4	55.0	0.0	84
40 44	70 00	W. by S. ¼ S.	233	24.1	290	8.5	*w* 27.2	11.9	52.4	6.6	62
40 29	74 00	W. ¼ S.	184	11.3	204	0.0	*w* 21.1	13.5	65.4	1.9	106
			2796		3304						

Average sailing distance from 10° W. by this route, 3,304 miles; for 508 of which the winds average ahead. It will be observed that from Longitude 25° to 35°, a vessel is more liable to adverse than fair winds, and further, that in this month the winds prevail very much from the westward, though not so much so as in some of the other months. From port, steer for Longitude 10° in Latitude 49°.

EUROPE TO NEW YORK—MARCH.

Latitude.	Longitude.	Courses.	DISTANCES. True.	DISTANCES. Per Ct.	DISTANCES. Average.	WINDS; PER CENT. Head.	Slants from. N'd.	Slants from. S'd.	Fair.	Calms.	Total No. observ'ns.	
49°30′	5°00′ to											
50 00	6 54	W. N. W.	79	6.6	85	0.0	w16.6	8.3	75.1	0.0	12	From
50 49	10 00	W. N. W.	128	15.4	147	3.0	14.0	14.0	69.0	2.7	38	Channel.
50 00	13 06	W. S. W.	128	25.9	161	10.0	16.4	18.0	55.6	3.5	110	
49 30	15 00	W. S. W.	79	23.0	97	3.0	w38.0	21.0	38.0	0.0	67	
49 30	20 00	W.	195	24.6	244	6.0	w26.0	23.0	46.0	0.0	74	
49 30	25 00 *d*	W.	195	17.5	228	3.3	17.0	w25.3	54.4	2.2	90	
46 05	30 00	W.	290	26.5	366	9.0	w30.8	8.2	52.0	1.1	90	
46 05	35 00	S. W.	208	14.8	238	3.4	15.4	w21.0	60.2	1.7	59	
46 05	40 00	W.	208	25.0	260	9.1	7.0	w25.0	58.9	1.2	82	
46 05	45 00	W.	208	22.6	253	6.0	19.0	20.0	55.0	1.5	67	
46 05	50 00	W.	208	12.6	234	6.0	w 6.0	3.0	85.0	0.0	36	
45 00	53 40 *d*	W.	170	10.0	187	0.0	w25.0	0.0	75.0	8.3	13	
44 37	55 00	W. S. W.	61	13.9	143	4.7	w12.3	8.4	74.6	0.9	108	
43 08	60 00	W. S. W.	234	8.9	255	0.9	w16.9	8.9	73.3	5.3	118	
41 36	65 00 *d*	W. S. W.	239	17.3	280	4.2	w18.2	14.1	63.5	4.1	126	
40 02	70 00	W. S. W.	245	17.2	286	4.1	w18.8	12.8	64.3	1.4	200	
39 37	71 00	W. S. W.	65	19.4	77	5.7	15.2	14.4	64.7	2.0	457	
40 27	74 00 *d*	W.byN.¾N.	146	20.7	176	5.5	w20.0	15.6	58.9	3.0	304	
			3,086		3,722							

Average sailing distance from 5° W. by this route 3,722 miles. The average per centum of adverse winds is equivalent to winds *dead ahead* for 636 miles. It will be observed that the most difficult part of this route is between Longitude 10° and 30° W., where there are few calms, but a great prevalence of westerly winds.

EUROPE TO NEW YORK—APRIL.

Latitude.	Longitude.	Course.	DISTANCE. Direct.	DISTANCE. Per Ct.	DISTANCE. True.	WINDS; PER CENT. Head.	North.	South.	Fair.	Calms.	Total No. observ'ns.	
49°30′	5°00′to											
49 30	10 00	W.	195	9.0	213	5.5	w11.0	5.5	78.0	5.6	19	From
49 30	15 00 *d*	W.	195	12.7	230	1.1	14.7	13.2	71.7	0.0	89	Channel.
50 40	10 00											
49 30	15 00	W. ¾ S.	205	21.0	248	7.5	17.1	18.2	57.2	4.0	85	
46 06	20 00	S. W.	289	9.8	317	9.8	w18.0	13.2	49.0	7.5	86	
45 00	21 34	S. W.	93	11.9	104	2.5	w14.3	11.7	71.5	5.9	125	
44 46	25 00	W. ½ W.	147	15.1	168	0.0	14.0	w33.6	52.4	5.7	37	
45 00	30 00	W. ½ N.	147	16.2	171	6.0	7.5	w13.0	73.5	4.5	70	
44 46	35 00	W. ½ S.	147	16.8	172	6.7	8.6	w10.5	74.2	1.0	104	
44 46	40 00	W.	313	20.2	256	12.4	12.5	w22.9	52.2	2.7	115	
44 46	45 00	W.	213	27.5	271	7.1	23.9	24.0	45.0	2.7	115	
44 46	50 00 *d*	W.	213	18.7	253	5.2	14.7	w17.3	62.8	6.9	115	
43 16	55 00	W. S. W.	234	22.9	268	8.2	w18.1	10.0	63.7	10.1	120	
41 43	60 00	W. S. W.	242	14.3	276	4.1	14.7	w26.2	55.0	4.1	126	
41 43	65 00 *d*	W.	223	22.4	272	6.5	19.5	19.5	54.5	7.5	86	
40 27	70 00	W. ¾ S.	240	19.9	268	7.3	w14.8	12.8	66.4	2.5	161	
40 27	74 00	W.	182	15.4	210	3.6	16.2	w19.8	60.4	7.1	180	
			2973		3437							

Average sailing distance from 5° W., 3,437 miles; average per centum of adverse winds equivalent to winds *dead ahead* for 464 miles. Frequent calms in this month.

EUROPE TO NEW YORK—MAY.

Latitude.	Longitude.	Course.	DISTANCES. Direct.	Per Ct.	True.	WINDS; PER CENT. Head.	North.	South.	Fair.	Calms.	Total No. observ'ns.
Channel	to										
50°50′	10°00′	W. N. W.	209	7.8	225	2.8	11.2	2.8	83.2	5.5	38
50 50	15 00	W.	191	17.6	226	5.5	18.7	11.5	64.3	1.1	96
50 50	20 00	W.	191	13.2	216	4.4	5.5	15.4	74.7	6.7	95
50 50	25 00	W.	191	8.2	206	0.0	12.0	9.6	78.4	0.0	42
50 50	30 00	W.	191	20.5	228	9.6	6.4	12.8	71.2	3.2	32
49 30	35 00*d*	W. S. W.	209	14.1	237	2.9	5.9	17.7	73.5	0.0	17
46 08	40 00	S. W.	286	18.2	337	5.0	20.0	9.0	66.0	5.0	104
44 41	45 00	W. S. W.	228	15.2	261	0.0	24.0	28.0	48.0	3.9	53
44 41	50 00*d*	W.	213	21.3	258	7.0	9.8	23.2	60.0	4.8	195
44 41	55 00	W.	213	22.3	260	7.2	13.7	22.2	56.9	3 9	160
43 11	60 00	W. S. W.	234	18.0	276	3.1	15.8	21.3	59.8	3.0	170
41 39	65 00	W. S. W.	239	21.7	282	7.2	17.1	11.0	64.7	3.9	189
40 05	70 00	W. S. W.	245	27.2	310	10.6	17.1	13.0	59.3	7.3	281
Port		W. ½ N.	184	10.0	202	2.5	10.8	14.5	72.2	4.0	235
			3024		3524	From	Channel				
			2815		3299	"	Liverpool				

Aim to make a straight course from *d* to *d*.

Captain Oliver Eldridge of the Liverpool packet ship, the "Garrick,"—to whom I am indebted for much valuable information, and who is moreover a most zealous and efficient co-operator in collecting materials for these charts—reports on his last voyage from Liverpool, two deep-sea soundings. They were without bottom, but they are the first I have received from a merchant ship; and I quote them as well for their value as for the example which they afford to the industrious and intelligent navigator, as to what he may do in assisting men of science to solve this interesting problem, as to the depths of the sea. A line of deep-sea soundings hence to Europe would be of great value and interest. It is supposed that the depth of the sea in that quarter is not very great, and that therefore these soundings may be had without much trouble to those who may be disposed to undertake them.

The following is from the abstract log of the "Garrick," on her voyage from Liverpool to New York, May and June, 1852.

"30th May, Lat. 48° 5′ N., Long. 41° 39′ W.; temperature 55°; Let 1,150 fathoms line run out without finding bottom.

2d June, Lat. 45° 14′ N., Long. 46° 36′ W.; temperature 48°. No soundings with 450 fathoms line, and a strong current setting S. E. by E."

His distance per log was 3,385 miles, being only 86 miles more than according to the above route for May, he should have logged. This is but one of the many instances that I continually receive illustrative of the correctness of the routes recommended. Steer such courses, the tables say, you will meet on the average such and such winds; and the distance which you will have to sail in order to accomplish your voyage, will be so many thousand miles. The navigator does it, and in some instances the computed distance and the actual distance by the log, will be found after a voyage of 4,000 or 5,000 miles to differ only a few leagues. In this case of the "Garrick," the difference, though comparatively large, is less than 30 marine leagues.

EUROPE TO NEW YORK—JUNE.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			Direct.	Per Cent.	True.	Head.	North.	South.	Fair.	Calms.	
Channel	to										
48°18′	10°00′	W. S. W.	213	29.4	276	9.1	16.9	35.1		0.0	78
44 52	15 00	S. W.	292	12.1	327	1 7	21.0	9.3		8.4	129
41 13	20 00	S. W.	310	2.4	316	0.0	3.0	6.0		0.0	33
39 39	25 00	W. S. W.	247	14 2	281	4.0	18.0	11.4		0.0	51
39 39	30 00	W.	230	23.2	283	7.1	14.3	22.0	57.0	4.4	189
39 39	35 00	W.	230	12.5	259	0.0	12.0	20.0	68.0	5.6	200
39 39	40 00	W.	230	26.0	290	11.0	15.8	17.3	55.9	3.4	215
39 39	45 00	W.	230	18.2	272	5.0	8.0	24.5	62.5	3.4	213
39 39	50 00	W.	230	13.2	263	2.8	6.0	22.8	78.4	2.5	251
39 39	55 00	W.	230	22.3	281	7.2	10.0	22.3	65.5	4.1	281
41 13	60 00	W. S. W.	247	20.4	297	7.6	3.1	22.0	67.3	0.9	225
41 13	65 00	W.	226	25.3	283	8.0	7.0	36.0	49.0	3.8	210
40 28	70 00	W. by S.	231	30.0	300	14.0	7.5	19.4	59.1	3.5	235
Port		W.	184	19.3	220	6.2	11.5	23.3	59.0	2.7	232
			3330		3948						

A tedious time of the year is the month of June to the homeward-bound.

EUROPE TO NEW YORK—JULY.

Latitude.	Longitude.	Course.	DISTANCE.			WINDS; PER CENT.					Total No. observ'ns.
			Direct.	Per Ct.	True.	Head.	North.	South	Fair.	Calms.	
49°40′	5°00′ to										
48 18	10 00	W. S. W.	213	15.6	245	4.2	25.0	0.0	70.8	0.0	24
48 18	15 00	W.	200	23.0	246	5.5	27.5	14.3	52.7	2.2	94
44 50	20 00	S. W.	295	14.2	336	1.6	27.8	8.2	62.4	2.5	125
44 50	25 00	W.	212	37.8	292	15.0	15.0	30.0	40.0	2.8	36
44 50	30 00	W.	212	18.5	251	5.0	14.9	16.2	63.9	16.2	93
44 50	35 00	W.	212	11.0	235	3.0	4.0	14 0	79.0	7.4	104
44 50	40 00	W.	212	24.9	264	10.5	5.6	18.2	65.7	6.3	151
44 50	45 00	W.	212	14.8	244	5.4	8.1	8.7	77.8	4.7	155
44 50	50 00	W.	212	24.2	263	8.7	10.0	20.0	61.3	8.1	173
43 20	55 00	W. S. W.	233	20.0	279	5.5	17.8	17.1	59.6	5.4	236
41 48	60 00	W. S. W.	240	26.9	305	8.3	21.2	19.2	51.2	5.6	263
40 14	65 00	W. S. W.	245	35.0	330	13.6	19.8	21.3	45.3	8.4	350
40 14	70 00	W.	230	27.8	294	10.7	10.8	26.0	52.5	8.7	314
Port	74 00	W.	183	29.9	237	11.2	7.7	35.9	45.2	4.2	322
			3111		3821	From	Channel.				
			2950		3623	From	Liverpool.				

EUROPE TO NEW YORK—AUGUST.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Cent.	DISTANCES. Average.	WINDS; PER CENT. Head.	Slants from N'd.or E'd.	Slants from S'd or W'd.	Fair.	Calms.	Total No. observations.
49°40′	5°00′ to										
48 20	10 00	W. S. W.	210	19.0	250	5.6	11.2	16.8	66.4	0.0	36
44 55	15 00	S. W.	291	22.4	255	[illegible]	26.4	5.6	60.8	3.2	130
43 25	20 00	W. S. W.	234	14.9	269	6.2	12.4	0.0	81.4	6.2	17
41 54	25 00	W. S. W.	238	15.6	275	1.7	28.9	11.9	58.5	0.0	60
41 54	30 00	W.	223	16.8	260	5.8	11.6	11.6	71.0	2.9	35
41 54	35 00	W.	223	21.4	270	6.0	15.0	22.0	57.0	1.9	106
41 54	40 00	W.	223	18.6	264	4.8	12.0	20.8	62.4	4.7	133
41 54	45 00	W.	223	18.1	263	5.6	9.8	19.6	65.0	5.0	147
41 54	50 00	W.	223	16.3	259	7.8	4.2	7.2	80.8	3.7	166
40 20	55 00	W. S. W.	244	17.9	268	3.5	19.5	17.0	60.0	6.5	213
38 44	60 00	W. S. W.	250	22.7	306	6.6	12.6	20.4	60.4	7.9	164
40 20	65 00	W. N. W.	250	10.8	277	2.0	7.0	17.5	73.5	4.3	193
40 20	70 00	W.	229	19.0	272	7.5	9.6	16.2	66.7	6.3	336
40 20	74 00	W.	183	16.3	208	7.0	8.0	12.5	72.5	6.0	194
			3244		3696						

EUROPE TO NEW YORK—SEPTEMBER.

Latitude.	Longitude.	Course.	DISTANCE. True.	DISTANCE. Per Cent.	DISTANCE. Average.	WINDS; PER CENT. Head.	North.	South.	Fair.	Calms.	Total No. observations.
49°30′	5°00′ to										
46 09	10 00	S. W.	284	3.0	292	0.0	10.0	0.0	90.0	0.0	20
45 00	11 38	S. W.	98	13.3	111	1.8	19.8	12.6	65.8	1.8	57
44 00	15 00	W. S. W.	155	3.6	160	0.0	0.0	18.0	82.0	0.0	17
44 00	20 00	W.	216	7.7	231	0.0	22.0	5.5	72.5	0.0	18
40 18	25 00 *d*	S. W.	314	6.2	333	0.0	7.7	7.7	84.6	7.7	14
40 18	30 00	W.	229	19.6	274	6.8	18.7	10.2	64.3	7.0	62
40 18	33 00	W.	143	6.8	152	1.3	8.8	7.5	83.4	8.7	87
39 42	35 00 *d*	W. S. W.	94	14.0	107	6.2	2.6	11.3	79.9		
39 42	40 00	W.	230	15.2	265	4.4	13.2	13.2	69.2	0.0	95
39 42	45 00	W.	330	14.2	263	3.2	8.0	20.8	68.0	7.7	139
39 42	50 00	W.	230	16.7	269	6.3	3.5	16.8	73.4	5.1	145
39 42	55 00	W.	230	13.9	262	5.6	6.3	10.5	77.6	3.6	144
40 39	58 00	W. N. W.	149	16.1	173	4.4	10.8	16.0	68.8	4.0	148
38 45	65 00 *d*	W. S. W.	349	14.0	398	3.5	10.5	16.1	69.9	3.4	154
40 20	70 00	W. N. W.	250	19.1	298	6.5	9.5	16.5	67.5	5.4	194
Port		W.	183	16.4	212	6.3	5.4	20.7	67.6	4.5	115
			3384		3800						

The routes to and fro, between Europe and the United States, do not require any written explanation. If the navigator will project them, and then consult these pages and the Pilot Chart, he will never be at a loss as to his best course *on the average*. In projecting these tracks on his chart, he will find them running sometimes inconveniently near the land or over shoals. Of course he will not infer that he is recommended actually to stand over such places. The route of the tables being intended merely as a guide, from which the land as well as the winds and currents will sometimes turn him aside. Navigators who pursue these routes, will confer a favor by making a note of the fact in their abstracts, accompanied with an expression of their opinion as to the advantages of them, mentioning also whether they have had any longer or shorter passages than vessels sailing about the same time without the Wind and Current Charts on board.

I have already the pleasure to acknowledge my obligations to Captain Oliver Eldridge, of the "Roscius," for such an act of kindness. Under date of May 21, 1850, he writes: "In reply to your inquiries as to my opinion in regard to the New Sailing Directions and Routes recommended by yourself, I would say that as far as I have had opportunity of judging, I think they will be of great advantage, and in particular to that part of the commercial community who depend upon wind as a propelling power.

"On my last passage to Liverpool, I think it was lengthened some *two* or *three days* by not following more closely the directions recommended by you in your No. for January, 1850: as a ship that left New York with us, kept in company, or nearly so, to the longitude of 25°. The wind then came out ahead; we stood on the southern tack, and she on the northern, (as recommended by you.) The wind afterwards came N. N. E.; she brought up to Cape Clear, and we 200 miles south of it."

Explanation of the Route Tables.

Columns 1, 2 and 3 (see tables of routes, pp. 328 to 337, also those of the route to Rio,) explain themselves.

Column 4 gives the distance by middle latitude sailing to be run on the course in column 3, when the winds are fair.

Column 5, shows the per centage by which the distance in column 4 is to be practically increased on the average, by adverse winds. The numbers in this column are obtained upon this principle: that if a ship sail with the wind dead ahead, and within six points of it, she loses 62 miles in every hundred—that is, she has to sail 100 to make 38 miles good; when she sails within 4 points of her course, that is, when she has a *slant* wind that will allow her to lay within 4 points of her course, she loses 29 miles only in 100; and when she sails within two points of her course, that is, when she has a *slant* wind 4 points from the course she wishes to steer, she then loses only 7.6 miles in 100. In other words, a vessel sailing 5 knots an hour will get as far on her course in 5½ hours with a *slant* wind 4 points from her course, as she will, at the same rate, in 13 hours, with the wind *dead* ahead. According to the ratio here indicated, the 2 and 4 point *slant* winds, have been reduced to their equivalent as winds *dead* ahead, and this equivalent in distance is given in column 5.

Column 6 shows the distance in column 4 after the per cent. in column 5 has been added to it. It is the average distance to be sailed from point to point, not allowing for currents, and supposing the vessel to sail within 6 points of the wind when close hauled.

Column 7, shows the average per centage of winds that are *dead* ahead.

Column 8, shows the average per centage of *slant* winds from the northward or eastward that will head a vessel off the course given in column 3.

Column 9, shows the average per cent. of *slants* from the southward or westward that will head a vessel off the course given in column 3.

Column 10, shows the average per centage of winds that are entirely fair for the course given in col. 3.

Column 11, shows the average per centage of calms for each district of 5° square through which the course in column 3, leads.

Column 12, shows the number of observations from which the figures in the other columns, and the courses recommended, have been obtained.

When the winds are fair, and the vessel is near the route recommended, she should steer straight from *d* to *d*, instead of making a zigzag track as by the projection.

The letter *w*, where it appears in column 8 or 9, means that that side is the windward side. But it is not necessary so to designate the windward side. It is obvious from mere inspection.

The letter *e*, in the column of calms means that this part of the route is through the region of calms that border the northeast trade winds, North and South, or that that part of the ocean is peculiarly liable to calms.—(See Trade Wind Chart.)

The courses given are *true*.

It will be perceived by the tables that the average European passage in February, ought to be nearly two days shorter than it is either in January or March.

According to the Pilot Charts, I make the average distance to be sailed by a New York Packet ship by the routes, from January to April, not estimating for the set of currents, to be when bound—

TO LIVERPOOL.

In January	3075	miles to	10°	W., for	250	of which	a vessel	will have	winds	dead ahead.
February	3015	"	"	"	234	"	"	"	"	
March	3150	"	"	"	231	"	"	"	"	
April	3051	"	"	"	244	"	"	"	"	

TO ENGLISH CHANNEL.

In January	3300	miles to	5°	W., for	293	of which	a vessel	will have	winds	dead ahead.
February	3245	"	"	"	261	"	"	"	"	
March	3448	"	"	"	249	"	"	"	"	
April	3275	"	"	"	265	"	"	"	"	

According to the Log Books taken at random, both of Packet ships and transient traders, I find the average time between these meridians and New York to be as per statement subjoined;

When bound to Liverpool, average length of passage from New York to 10° W.			When bound from Liverpool, average length of passage from 10° west to New York.			When bound to English Channel, average length of passage from New York to 5° W.			When bound from English Channel, average length of passage from 5° west to New York.		
Month.	Days' passage.	Number of passages.	Month.	Days' passage.	Number of passages.	Month.	Days' passage.	Number of passages.	Month.	Days' passage.	Number of passages.
January	18	25	January	33	16	January	20	11	January	40	7
February	20	18	February	35	36	February	23	6	February	41	13
March	20	20	March	31	41	March	25	10	March	33	10
April	21	9	April	29	17	April	22	6	April	30	2

It is important that navigators should bear it in mind, that when the winds are fair, they are not expected to o make the zig-zag track of the tables, but to steer straight from *d* to *d*.

New York to New Orleans—Capt. Wm. C. Berry to Lieut. Maury—New York, Feb. 1, 1851.

"Having had long experience in the trade between New York and New Orleans, I herewith furnish you with a few remarks on wind and currents. For the last six years I have commanded the ship Vicksburgh, constantly trading between these two ports. In making the passage out, after passing the Hole-in-the-Wall, I have frequently found a current from 1 to 3 miles per hour, setting to the eastward through the northwest channel of Providence, particularly after the wind has prevailed from the westward a few days. This, no doubt, has been the cause of putting a number of vessels on shore among the Berry Islands. I have latterly made it a point to take the last bearings of the light on the Hole-in-the-Wall, and either haul up or keep off as I found the current; generally running on a West course until quite down with Little Stirup Keys, then steering W. by N. ½ N., by compass if in the night, until I was up with the Great Isaacs. The last three voyages having reached the vicinity of the Little Isaacs in the day time. I have hauled in on the Bank between the western Little Isaacs and the East Brother Rock, and steered S. W. by W., by compass, which has brought me out in good passing distance from the Moselle shoal—during one of my summer passages out, after passing the above shoal I was compelled to anchor and remained there for six days, the wind during all this time was light from the southward, and I could not help remarking the regularity of the current setting along the Bemini Islands, ebb and flow, about two miles per hour; this continues as far as Gun Key, when it is broken off by the Gulf which sets close into the Key. From this point up to Orange Key, when close in, little or no current is experienced except the ebb and flow, which is directly off the Bank. In crossing the Santaren channel the current is governed greatly by the winds; with strong southerly winds the current sets about N. N. W., two miles per hour; on the other hand, with strong northerly winds, little or no current is felt. After leaving the Double-Headed-Shot Key, I have generally hauled over for the Florida Reef, and in the day time kept close in, when I have frequently found an eddy current setting to the westward from 1 to 1½ miles per hour. After passing the Tortugas, I have invariably felt a southerly current until I had reached the Long. of 84° 30′ W., and even further than this at times, as will be seen by referring to my journals, particularly in November, 1848. Returning from New Orleans, I have always made it a point to keep to the westward until I had reached the Long. 85°,

Lat. 28°, before keeping off; my object in doing this is that the wind here generally prevails from the northward and eastward, and that the current generally sets to southward and eastward, which greatly facilitates the passage after rounding the Tortugas with the wind from the eastward, I have generally beat down on the Florida side, knowing that the strongest current prevails on that shore, unless too close in. From Carrysfort Reef to Mantanilla I have always endeavored to keep in the centre of the stream. During all my voyages I have made it a rule to steer from Mantanilla to Lat. 29°, N. by W., and then North to Lat. 31° before hauling up N. E. by N.; by so doing I have, with a few exceptions, kept the strongest current. On some other occasions I have hauled up on a N. E. by N. course when in Lat. 30°, Long. 79° 40′, and have soon found myself on the eastern edge of the Gulf. After rounding Cape Hatteras it is advisable to keep to the westward, especially in the winter season, on account of the prevailing westerly winds."

Sailing Directions for the Coatzacoalcos river—Capt. Foster, of the "Alabama," to Lieut. Maury.

"Sailing vessels bound for the Coatzacoalcos ought to make the land to the eastward. This precaution is necessary on account of the prevailing trade winds which cause a strong westerly current; also in case of a norther, to have the advantage of sea-room. The entrance to the river may be known by the vigia or tower situated upon the western side; likewise from the sand cliffs extending from that point to the westward.

The best mark for crossing the bar is to bring the tower* to bear S. ¾ W. by compass. Having passed the bar haul up to the East of South, and steer in midway between the two points that form the entrance to the river. The wind, after crossing the bar, often falls to calm; for this reason it is necessary to have an anchor ready to let go, as the current on the ebb, even in the dry season, sets out strong.

The extent of the bar, East and West, is about 220 fathoms, and the width, by actual measurement, 108 feet. The bottom composed of sand and clay is hard, on which account it is not liable to shift. It forms in hard northerly gales, a narrow barrier of breakers, and cannot be crossed without imminent risk. The depth at high water on full and change is about 13 feet, and falls as low as 10 6 feet. The general depth, however, is 12 feet, from which it suddenly deepens to 5 or 6 fathoms.

Except in heavy weather, there prevails a regular land and sea breeze. The latter sets in between the hours of 9 A. M. and noon.

APRIL, 1851."

Letters of Lieutenants Foot and Porter—Coast of Africa.

UNITED STATES BRIG PERRY,

St. Paul de Loanda, May 17th, 1851.

SIR:—In a letter addressed to the commander of any U. S. vessel who may come to the Southern Coast, I have enclosed a copy of notes drawn up by Lieutenant Porter, who has cruised on the southern coast of Africa, severally in the Marion, John Adams, and this vessel.

* This tower of great solidity, is destined to last for ages.

I transmit a copy of these notes, (which fully accord with my own observations and experience,) under the impression that they may be available in the Hydrographical Department.

I have the honor to be,

Very respectfully, your obedient servant,

ANDREW H. FOOTE,

Lieut. Commanding.

COMMODORE LEWIS WARRINGTON,

Chief of the Bureau Ordnance and Hydrography.

PASSAGE FROM THE CAPE DE VERDS TO THE S. W. COAST OF AFRICA, WITH REMARKS UPON THAT SECTION OF THE COAST.

Lt. W. C. B. S. Porter, U. S. N., to Andrew H. Foote, Lt. Com'd'g U. S. Brig Perry—LOANDA, *May 17th*, 1851.

"In the season of February, March, April, and May, there is no difficulty in making the passage from Porto Praya to Ambriz in thirty days, provided the run from Porto Praya to Monrovia takes not more than eight days.

The direct route, and that which approaches the great circle, leads along the coast, touching the outer soundings of St. Ann's shoals, thence to Half-Cape Mount, to allow for a current when steering for Monrovia. From there, follow the coast along with the land and sea breezes, assisted by the current, until you arrive at Cape Palmas; keep upon the starboard tack notwithstanding the wind may head you in shore, (the land breezes will carry you off,) and as the wind permits, haul up for 2° West longitude; cross the equator here if convenient, but I would not recommend going to the westward of it, you will encounter westerly currents from thirty to fifty miles a day. In the vicinity of Prince's Island the S. W. wind is always strong. In the latitude of about 1° 30′ N. there is a westerly current. Should it not be practicable to weather the Island of St. Thomas, stand on, approach the coast, and you will meet with North winds to carry you directly down the coast. Our Salem vessels make the passage from the United States in 56 days, arriving at Ambriz in May. I have made three different cruizes to this coast in the same season, in the Marion, John Adams and Perry.

The impulsive desire to attain the object of our duty will, as much in nautical matters as others, mislead our better judgment, when there is a prospect, or any temptation to success, without experience to forewarn us. Thus, our vessels, after arriving at Cape Palmas, have generally gone upon the port tack, because the wind carried them towards the coast or Gulf of Guinea, and seemed to favor them for the port tack the most; which, on the contrary, although slowly veering towards the S. E., was hauling more ahead, and leading them off into a current, which, under a heavy press, it is impossible to work against. The consequences were, they had to go upon the starboard tack, and retrace the ground gone over. On the starboard tack, as you proceed easterly, the action of the wind is the reverse, and it allows you to pursue the great-circle course.

It employed the Marion eighty-odd days to Kabenda, a port 200 miles nearer than Ambriz; to which port (Ambriz) from Monrovia, in this vessel, (the Perry,) we went in 23—making 31 from Porto Praya. In the

John Adams, 10 to Monrovia, and 46 to Ambriz, by the way of Prince's Island; about 10 of which was lost working to the south of Cape Palmas. From Cape Palmas to the point of crossing the equator the current is easterly—south of that westerly.

The practice along the coast in this vessel (the Perry) was, to keep near enough to the land to have the advantage of a land and sea breeze, and to drop a kedge whenever it fell calm, or, we were unable to stem the current. Upon this part of the coast near the Congo, the lead line does not always show the direction of the current which affects the vessel. On the bottom there is a current in an opposite direction from the surface; therefore, before dropping the kedge, the better way is to lower a boat and anchor her—which will show the drift of the vessel. Between Ambriz and the Congo, I have seen the under current so strong to the S. E., as to carry a 24 pound lead off of the bottom, while the vessel was riding to a strong S. W. current—but the under current is the strongest.

In crossing the Congo, I would always suggest crossing close to its mouth, night or day; going North with the wind W. N. W., steer N. N. E., with a five or six knot breeze, when you strike soundings on the other side you will have made about a N. ½ E. course in the distance of 9 miles, by log from 11½ fathoms off Shark Point. The current out of the river sets West about 2 knots the hour. With the land breeze it is equally convenient; and may be crossed in two hours. In coming from the North, with Kabenda bearing N. E., in 13 fathoms, or from the latitude of 5° 48′—wind S. W., a S. S. E. course will carry you over in four hours outside of Point Padron—and by keeping along shore the current will assist you in going to the South. Vessels which cross to seaward from latitude of 5° 45′, and 9° W., are generally six days or more to Ambriz; by the former method it occupied us (the Perry) only two days."

Lieut. Maury to the Secretary of the Navy.

I have the honor to report to you, for the benefit of navigation, the accompanying "Notice to Mariners," which is derived from the "Wind and Current Charts," in process of construction at this office.

I would recommend that all vessels, whether public or private, bound hence in the months named, to ports in the Pacific, Indian, or South Atlantic Oceans, should try these routes, because they are derived from the results of many thousand voyages, and are, in fact, the combined experience of thousands of navigators.

These routes therefore are not dependent upon any theory; they are the results of actual observation. If the navigators who have furnished me with copies and abstracts of their logs have (and they doubtless have) reported correctly the direction of the winds encountered by them, then there is no doubt as to the practicability of these routes. The advantages which they offer are of commercial and national importance.

A vessel that pursues them, instead of the old or usual route hence to the equator, will save from one thousand to fifteen hundred miles in distance, and gain on the average from a week to ten days that far on the passage to the ports of India, China, South America, California, and all the markets of the Pacific Ocean.

Careless navigators in slow sailing vessels, may try these routes, fall to leeward, and bring them into disrepute. To prevent this, it is a matter of great importance that their practicability should be tested by fair sailers, under skillful navigators.

You will therefore perhaps encourage the hope that the Department will, at an early day, find it convenient to avail itself of the authority granted by Congress, and detail two suitable vessels of the Navy for the purpose of trying these routes, and of co-operating with the "Taney" in making those other observations which are required to assist me in the construction of these charts, and which are necessary to perfect them.

NATIONAL OBSERVATORY, Dec. 14, 1849.

NOTICE TO MARINERS.

It is well known that the route to every port in the Pacific, Indian, and South Atlantic Oceans, is the same as far as the equator; and indeed until Cape St. Roque in Brazil, be cleared.

It is also well known that this common part of the route varies according to the season of the year.

Since the first publication of the "Wind and Current Charts," the materials for improving them have increased with great rapidity. These materials have been so discussed and arranged by the officers at the Observatory that, with the aid of the "Pilot Chart," the navigator may now calculate and project the path of his ship on an intended voyage, very much in the same way that the astronomer determines the path of a comet through the heavens. There is this difference, however: the chart with its data shows the navigator that, in pursuing his path on the ocean, head winds and calms are to be encountered, which will turn him aside or retard him on his way; and that therefore he cannot predict with certainty the place of his ship on a given day. He, therefore, in calculating his path through the ocean, has to go into the doctrine of chances, and to determine thereby the degree of probability as to the frequency and extent with which he may anticipate adverse winds and calms by the way.

Thus in the 5 degrees square of the ocean, between latitude 35° and 40° N., longitude 70° and 75° W., the log books of 4,387 vessels, or the records of vessels for 4,387 days in this square, have been examined; 323 of which were there in the month of February of different years.

Now supposing (and there is no reason to suppose otherwise) that these observations give a fair average as to the prevalence of calms, and the direction of the winds: we are led to the conclusion that if one of these vessels had attempted to sail through this square one hundred times on an E. S. E. course, in the month of February for a series of years, she would have had 6.2 calms, fair winds 85.5, and 1.3 wind *dead ahead* or at E. S. E.; that she would have been headed off on the larboard tack, or by "slant" winds from the northward and eastward 7.3 times; and on the starboard tack, or by "slant" winds from the southward, 5.9 times.

From this, the navigator will see also, that along this part of the February route, the northern side is rather the windward side; and that, therefore, when winds are *free* it is better to keep, along this part of the route, somewhat to the North of the projected line.

After crossing latitude 20° N., longitude 40° W., he will likewise see that he is there still liable to be headed off by winds from the northward and eastward, and that, consequently, when the wind comes out *dead* ahead, he should stand off on the starboard tack; and that, when the winds are fair, he should keep the projected track to the southward and westward of him, say generally 40 or 50 miles.

He is recommended to steer straight from *d* to *d* when the winds are fair; and when he gets thrown off his course, instead of getting out of his way to get back to the projected track, he should be guided by the "Pilot Chart," and run parallel to this track, or otherwise, according to the "Pilot Chart."

Similar tables, with complete sailing directions, are in the course of preparation for every month, and all the principal routes across the ocean.

These present tables from that publication are given for the information of those navigators who are on the eve of sailing on voyages beyond the equator.

Those who desire to try these routes should project the route for the month on the chart as far as the equator; arrived there, let a line be drawn from the point of *actual* crossing to Cape St. Augustine; and then aim to keep this line under the *lee*, so as to have it at least 20 or 30 miles to the westward when the ship crosses the parallel of 6° or 7° South.

After that, the winds haul more to the eastward, and there will be no difficulty in laying up S. S. W., or even as high as South.

If the ship be headed off to the west of her course or to the west of said line to St. Augustine, she should take advantage of the first "slant," tack, stand east, and make short and long legs until she can clear the land.

This part of the route is the turning point of the passage. By studying the charts as well as the tables, navigators will see, that with attention and management between the equator and 6° South, they will have little or no difficulty in making either a S. S. W. course good on one tack, or an east course on the other; and when they find it necessary to stand to the eastward, they should never stand farther unless they can make southing also, than to bring 20 or 30 miles to the leeward of them, a straight line drawn from 31° on the equator just so as to clear the land about Cape St. Augustine. In this part of the route more than in all others, the navigator should study the *slants*, and take advantage of all of them.

I recommend these routes, it should be understood, only to vessels which can sail within six points of the wind. I would not advise any vessel that cannot do this, to attempt them, for she will be apt to fall to leeward, and then she will find it difficult and tedious to get up again.

There are other parts of the routes in which it is also necessary to study the "slants." For instance: take that part of the February route which lies between the parallels of 20° and 15° N. It will be observed that though but one of the 25 observations from which this part of the route is determined, gives the wind

directly ahead, yet that 8 per cent. of them are "slant" winds from the eastward, which will prevent a vessel 8 times in 100 from lying S. S. E., the course prescribed.

After crossing 15° it will be seen that the navigator will have—if the observations consulted give a fair average as to the direction of the wind—neither head winds nor "slants"—until he gets 5° N. Thence to the equator he is liable to be headed off to the westward 14.7 times in 100. He should therefore in this month aim, if the winds allow, to keep this part of the route under the lee, so as to cross 5° N. to the east of 31°.

By "*slants*" I mean winds, that though not *dead* ahead, will nevertheless head a ship off her course—thus, for a vessel that wishes to head E., a wind at N. N. E. or N. E. would be what here is called a *slant* wind.

The route for each month is computed according to the doctrine of chances; the number of observations from which each part of the route is calculated is stated in the last column, "Total number of observations."

It will, therefore, be perceived that some parts of each route are entitled to more weight than others. Thus the per centage of fair and adverse winds for the first course on the December track is derived from 364 observations, whereas that for the fifth course is derived from only 26. All will admit that 364 give a better average than do only 26 observations.

It must be further presumed and admitted that vessels may expect, in following any one of these routes, *sometimes* to encounter head winds and calms, and have long passages.

But, taking the average length of passage by these routes, the data of the charts lead us to the conclusion that a fair sailer, under good management, will run in December from 31 to 36 days from the Atlantic ports to the equator; in January from 30 to 35 days: and in February and March from 19 to 27 days, against 41 days by the old or usual route.

Navigators who are disposed to try these routes should have the "Pilot Charts" on board; which "Pilot Charts" will be furnished to them on application, either at the National Observatory at Washington; or to George Manning, No. 142, Pearl-street, New York; provided the applicant will agree to furnish this office an abstract of his log according to the form with which he will also be gratuitously supplied, and which form may be found in another part of these directions.

Vessels from other ports of the United States, besides New York, are recommended to make the best of their way to the track from New York. They should generally be governed by the winds they happen to meet as to where they will intercept this track. If vessels from southern ports aim to intercept it to the S. of 33° N., they will be liable to encounter the calms of the Horse Latitudes.

NATIONAL OBSERVATORY, *Washington*, *December* 14, 1849.

Best average routes from New York to Rio, and ports beyond the Equator.

DECEMBER.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Ct.	DISTANCES. Average	WINDS; PER CENT. Head.	SLANTS FROM. N'd or E'd.	SLANTS FROM. S'd or W'd.	Fair.	Calms.	Total No. observ'ns.
From 40°27' N.	74°00' to										
39 12	70 00	E. S. E.	200	7.0	214	2.1	7.2	4.5	86.2	3.0	364
39 12	65 00 *d*	E.	233	6.4	248	2.0	5.0	7.0	86.0	1.5	195
35 12	60 00	S. E.	338	7.2	363	0.8	8.8	8.8	81.6	0.8	119
35 00	59 24	E. S. E.	31	10.9	34	4.0	7.0	7.0	82.0	1.0	100
33 29	55 00	E. S. E.	237	6.4	252	4.0	0.0	0.0	96.0	0.0	26
33 29	50 00 *d*	E.	350	3.7	259	0.0	0.0	*w* 9.2	90.8	0.0	44
31 44	45 00 *d*	E. S. E.	275	9.3	300	3.9	7.8	6.5	81.8	7.5*e*	75
30 00	43 00	S. E.	147	24.8	183	6.4	16.8	*w* 26.4	50.4	2.4	121
25 00	43 00	S.	300	9.6	329	2.0	12.0	12.0	74.0	6.0	48
22 16	40 00	S. E.	232	9.0	253	3.4	*w* 13.6	0.0	83.0	3.4	29
20 00	37 34 *d*	S. E	192	7.5	206	0.0	*w* 19.5	6.5	74.0	1.3	79
15 00	35 24	S. S. E.	325	4.3	339	0.0	*w* 7.2	4.8	88.0	2.4	42
14 37	35 00 *d*	S. E.	33	22.9	41	11.1	*w* 14.8	0.0	74.1	0.0	27
10 00	35 00	S.	277	1.4	281	0.0	*w* 6.0	0.0	87.0	0.0	25
5 00	30 00 *d*	S. E.	424	13.1	479	2.0	*w* 26.0	14.0	58.0	10.7*e*	50
Equator	32 04	S. S. W.	324	3.0	334	1.4	4.2	0.0	94.4	4.0	71

Shortest distance to the equator by this route, 3,918 miles; average distance to be sailed, on account of adverse winds, 4,115. Ship Bothnia, Captain Avery, in Dec., 1850, accomplished it in 29 days, and 4,077 miles per log.

It is only about in the proportion of 1 to 2 that a vessel in this part of the ocean can make a S. E. course from 10° to 5° N. Therefore vessels going the December route should always aim to cross 10° N. to the East of 35° W.

ROUTE TO RIO, ETC.—JANUARY.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Ct.	DISTANCES. Average	WINDS; PER CENT. Head.	SLANTS FROM N'd or E'd.	SLANTS FROM S'd or W'd.	Fair.	Calms.	Total No. observ'ns.
From 40°27' N.	74°00' to										
40 27	70 00	E.	182	6.2	193	2.0	6.0	5.0	87.0	2.1	97
38 52	65 00	E. S. E.	249	7.4	266	2.4	5.6	5.6	86.4	0.8	118
38 52	60 00 *d*	E.	243	6.7	249	0.9	3.6	*w* 11.7	83.8	3 4	113
37 14	55 00	E. S. E.	255	7.5	274	2.4	3.2	*w* 8.8	85.6	0.0	128
35 35	50 00	E. S. E.	260	8.3	283	3.0	7.0	8.0	82.0	4.5	105
35 00	48 17 *d*	E. S. E.	92	11.4	103	4.4	6.6	*w* 13.2	75.8	0.0	91
30 00	45 49	S. S. E.	324	12.1	362	1.9	15.2	*w* 19.0	63.9	10.0	54

ROUTE TO RIO, ETC.—JANUARY—CONTINUED.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			True.	Per Ct.	Average	Head.	SLANTS FROM Nd. or Ed.	SLANTS FROM Sd. or Wd.	Fair.	Calms.	
29°44' N.	45°00' N.	E. S. E.	42	25.7	53	8.4	*w* 25.2	11.8	49.8	4.2	24
25 20	40 00	S. E.	347	13.6	425	3.3	*w* 16.4	8.2	72.1	1.6	61
25 00	39 38 *d*	S. E.	34	28.0	43	13.2	8.7	*w* 11.0	67.0	3.3	88
20 00	37 16	S. S. E.	324	6.4	344	2.5	5.5	5.5	87.5	0.0	80
15 00	35 00	S. S. E.	324	7.7	348	0.0	*w* 15.8	10.5	73.7	0.0	19
10 00	32 53	S. S. E.	324	0.4	325	0.0	*w* 3.0	0.0	97.0	0.0	33
5 00	30 48 *d*	S. S. E.	324	1.6	329	0.0	*w* 8.0	0.0	92.0	0.0	25
Equator.	30 48	S.	300	0.7	302	0.0	*w* 6.6	0.0	93.4	0.0	88
1 00 S.	31 13	S. S. W.	65	3.7	67	0.0	*w* 15.0	0.0	85.0	0.3	294
2 54	32 00	S. S. W.	123	6.1	130	0.0	*w* 23.9	0.0	76.1	0.0	46
5 00	32 52 *d*	S. S. W.	137	5.8	145	0.0	*w* 28.6	0.0	71.4	0.0	21
5 08	33 00	S. W.	12	0.0	12	0.0	0.0	0.0	100.0	0.0	29
7 00	34 00	S. S. W. ½ W.	136	5.1	143	0.0	*w* 14.4	0.0	85.5	0.0	28
9 00	34 50	S. S. W.	130	5.3	137	2.9	2.9	0.0	97.1	8.0	34

Shortest distance to the equator by this route, 3,640 miles. Average distance to be sailed on account of adverse winds, 3,899 miles. The "Surprise" in January, 1851, accomplished it in 24 days, and 3,852 miles per log.

The courses from 35° N. to 30° N., and from 7° S. to 9° S., run through a part of the ocean that is liable to calms. In the adjacent wind-roses to the East of these (see Pilot Charts,) there is less liability to calms. From New York to the parallel of 25° N., in this month, the South is generally the windward side. Thence to the line it is to leeward. Prefer, therefore, in this month, to cross 25° N. to the E. of 40°, and 7° S. to the E. of 34° W. Long.

ROUTE TO RIO, ETC.—FEBRUARY.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			True.	Per Ct.	Average	Head.	SLANTS FROM Nd. or Ed.	SLANTS FROM Sd. or Wd.	Fair.	Calms.	
From 40°27' N.	74°00' W.	to									
39 11	70 00	E. S. E.	199	5.1	209	1.3	7.3	5.9	85.5	6.2	303
37 33	65 00	E. S. E.	256	2.7	263	0.0	5.7	2.3	92.0	4.5	87
35 53	60 00	E. S. E.	263	1.2	280	7.0	9.0	6.0	84.0	1.0	100
35 53	55 00 *d*	E.	243	7.2	260	3.0	5.0	4.0	88.0	1.0	100
35 00	53 12	E. S. E.	144	5.7	151	1.3	12.2	14.8	78.4	4.0	74
33 21	50 00	S. E.	225	0.0	225	0.0	0.0	0.0	100.0	3.5	28
32 54	48 13	E. S. E.	98	2.1	100	0.0	5.5	5.5	88.9	0.0	18
30 00	45 00	S. E.	240	3.8	249	0.0	5.5	11.1	83.4	0.0	18
25 38	40 00 *d*	S. E.	372	0.0	372	0.0	0.0	0.0	100.0	0.0	20
25 00	40 00	S.	38	11.5	42	3.7	14.8	7.4	74.1	18.2*e*	27
20 00	37 45	S. S. E.	324	9.3	354	4.8	1.6	3.2	90.3	3.1	62
15 00	35 35	S. S. E.	324	1.6	329	0.0	*w* 8.0	0.0	92.0	0.0	25
10 00	33 28	S. S. E.	324	0.0	324	0.0	0.0	0.0	100.0	0.0	31
5 00	31 23 *d*	S. S. E.	324	0.0	324	0.0	0.0	0.0	100.0	5.3*e*	18

ROUTE TO RIO, ETC.—FEBRUARY.—Continued.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Ct.	DISTANCES. Average	WINDS; PER CENT. Head.	SLANTS FROM Nd. or Ed.	SLANTS FROM Sd. or Wd.	Fair.	Calms.	Total No. observ'ns.
Equator.	31°23′ *d*	S.	300	3.7	311	0.0	*w* 14.7	0.0	85.3	2.7	108
1°00′ S.	32 00	S. S. W. ¾ W.	72	5.1	76	0.0	*w* 19.0	0.0	81.0	1.7	289
3 00	32 50	S. S. W.	130	6.5	138	0.0	*w* 21.6	0.0	78.4	0.0	28
3 24	33 00	S. S. W.	26	0.0	26	0.0		0.0	100.0	0.0	9
5 00	33 40	S. S. W.	104	3.0	107	0.0	*w* 25.0	0.0	75.0	0.0	12
7 00	33 40 *d*	S.	120	0.0	110	0.0	0.0	0.0	100.0	0.0	11
7 48	34 00	S. S. W.	52	0.0	52	0.0	0.0	0.0	100.0	0.0	22
9 00	34 30	S. S. W.	78	5.2	82	0.0	*w* 13.0	0.0	87.0	0.0	23

Shortest distance to the equator by this route, 3,674 miles. Average distance to be sailed on account of adverse winds, 3,793.

The route for this month is the most favorable. In no part of it is the average of winds that are entirely fair less than 74 in 100; and generally the northern or larboard side is the windward side. The passage to the Line has been frequently made by vessels that have followed this route, in 19 and in 20 days.

ROUTE TO RIO, ETC.—MARCH.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Ct.	DISTANCES. Average	WINDS; PER CENT. Head.	SLANTS FROM Nd. or Sd.	SLANTS FROM Sd. or Wd.	Fair.	Calms.	Total No. observ'ns.
From 40°27′ N.	74°00′ to										
39 11	70 00	E. S. E.	199	9.6	218	2.2	*w* 10.7	7.5	79.7	2.0	448
37 43	65 00	E. S. E.	256	7.0	274	1.4	7.8	7 0	83.9	2.0	353
36 03	60 00	E. S. E.	261	6.7	278	2.4	6.6	3.0	88.0	6.7	181
36 03	55 00 *d*	E.	243	6.5	259	2.1	6.3	4.9	86.7	4.7	142
35 00	53 43	S. E.	89	6.1	94	0.9	1.8	*w* 14.4	82.9	4.2	113
31 53	50 00	S. E.	265	12.6	298	6.0	4.5	3.0	86.5	0.0	65
30 05	45 00 *d*	E. S. E.	284	12.2	318	5.1	6.8	6.8	81.3	0.0	60
25 00	45 00	S.	305	8.8	331	0.0	*w* 15.5	12.4	72.1	8.6	32
20 23	40 00	S. E.	399	10.5	441	0.0	*w* 22.5	15.0	62.5	0.0	40
20 00	39 35	S. E.	33	4.5	34	0.0	6.0	*w* 12.0	82.0	2.0	45
15 36	35 00	S. E.	370	3.7	484	0.0	*w* 14.8	0.0	85.2	0.0	27
15 00	34 23 *d*	S. E.	51	10.1	56	3.6	7.2	7.2	82.0	0.0	56
10 00	32 16	S. S. E.	324	1.0	327	0.0	*w* 5.1	0.0	94.9	0.0	60
5 00	30 10 *d*	S. S. E.	324	9.8	355	3.9	*w* 11.7	1.3	83.1	3.7	78
Equator	30 10 *d*	S.	300	3.0	309	1.4	*w* 2.8	0.0	95.8	2.0	143
1 00	30 35	S. S. W.	65	2.1	66	0.0	*w* 7.4	0.0	92.6	4.8	299
1 25	31 00	S. W.	35	4.0	37	0.0	*w* 13.4	0.0	86.6	0.0	15
3 00	31 40	S. S. W.	103	0.0	103	0.0	0.0	0.0	100.0	0.0	6

ROUTE TO RIO, ETC.—MARCH—Continued.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Ct.	DISTANCES. Average	WINDS; PER CENT. Head.	SLANTS FROM. Nd. or Ed.	SLANTS FROM. Sd. or Wd.	Fair.	Calms.	Total No. observ'ns.
S. 3°48'	32°00' to	S. S. W.	52	8.8	56	0.0	w 22.2	0.0	77.8	0.0	9
5 00	32 30	S. S. W.	78	0.0	78	0 0	0.0	0.0	100	0.0	10
6 12	33 00	S. S. W.	78	0.0	78	0.0	0.0	0.0	100	0.0	15
7 00	33 20	S. S. W.	52	0.0	52	0 0	0.0	0.0	100	40.	25
8 36	34 00	S. S. W.	104	4.5	109	0.0	w 14 0	0.0	86.0	0.0	49
9 00	34 10	S. S. W.	26	3 2	27	0 0	w 9.8	0.0	90.2	0.0	82

Shortest distance to the Equator by this route, 3,703 miles. Average distance to be sailed on account of adverse winds, 3,976 miles.

This and the February route are the most favorable. After crossing 5° N. if you can lay up S. S. E., to the Line, do so. For full explanations of these tables, see explanations in another place.

ROUTE TO RIO, ETC.—APRIL.

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Pr. Ct.	DISTANCES. Average.	WINDS; PER CENT. Head.	SLANTS FROM N. & E.	SLANTS FROM S. & W.	Fair.	Calms.	Total.
From	S. Hook to										
39°10'	70°00'	E. S. E.	200	10.7	221	3.6	w 11.1	5.3	80.0	4.0	523
39 10	65 00	E.	233	9.3	256	3.7	w 9.3	6.2	80.8	4.5	320
37 33	60 00	E. S. E.	254	6.2	274	2.0	w 6.6	4.0	87.4	3.2	151
35 54	55 00	E. S. E.	260	5.4	276	0.7	8.0	8.8	82.5	4.9	136
35 54	50 00	E.	243	6.1	258	0.0	w 12.2	7.2	81.6	8.1	125
35 54	45 00	E.	243	5.8	257	0.0	w 12.3	3.7	84.0	5.8	81
35 00	42 21	E. S. E.	141	7.7	152	1.5	6.2	w 10.8	81.5	0.0	65
30 00	40 00	E. S. E.	312	17.4	366	6.3	6.2	w 32.5	55.0	1.0	95
25 00	37 40	S. S. E.	325	13.8	369	3.0	17.0	w 19.0	61.0	3.0	97
20 00	35 26	S. S. E.	325	2.6	333	0.0	5.4	w 7.2	87.4	5.1	56
15 00	33 16	S. S. E.	325	2.0	331	2.0	0.0	0.0	98.0	0.0	49
10 00	31 09	S. S. E.	325	0.0	325	0.0	0.0	0.0	100.0	4.4	43
5 00	29 04	S. S. E.	325	0.6	327	0.0	1.7	0.0	98.3	0.0	59
Equator.	29 04	S.	300	2.1	306	0.0	w 5.9	1.3	92.8	6.8	152
			3811		4051						
S. 1 00	29 29	S. S. W.	65	4.4	68	0.0	w 17.7	0.9	81.4	5.5	344
1 31	30 00	S. W.	44	3.3	45	0.0	w 16.7	0.0	83.3	0.0	12
2 31	31 00	S. W.	85	2.4	87	0.0	w 8.4	0.0	91.6	0.0	12
3 00	31 12	S. S. W.	31	2.4	32	0.0	w 12.0	0.0	88.0	15.0	17
5 00	32 02	S. S. W.	130	4.0	135	0.0	w 20.0	0.0	80.0	12.5	15
7 19	33 00	S. S. W.	150	2.7	154	0.0	w 13.3	0.0	86.7	0.0	15
9 00	33 42	S. S. W.	109	3.2	112	0.0	w 10.8	0.0	89.2	0.0	55

Observe that between the meridians of 55° and 60°, the calms of the Horse Latitudes most prevail between the parallels of 21° and 27° N.; and between the parallels of 28° and 32°, between the meridians 40° and 45°.

The equatorial calms in April, between 25° and 30° W., prevail from 5° S. to 3° N., being most prevalent between 1° S. and 1° N. Between 30° and 35° W., they prevail from 3° N. to 3° S. being most prevalent between 2° N. and the Line.

Observe also how the winds in this month hang from the Southward, in latitude 35° to 30° N., and between the meridians of 40° and 45° West.

ROUTE TO RIO, ETC.—MAY.

Latitude.	Longitude.	Course.	Distance. True.	Distance. Per Ct.	Distance. Average.	Winds; per cent. Head.	Slants from N. & E.	Slants from S. & W.	Fair.	Calms.	Total.
From port to											
39°11′	70°00′	E. S. E.	199	9.8	218	2.5	10.8	8.3	78.4	2.1	599
39 11	65 00	E.	238	11.5	464	6.4	12.8	11.2	69.6	2.8	315
37 34	60 00	E. S. E.	254	9.1	277	2.8	6.6	8.8	81.8	1.6	181
35 55	55 00	E. S. E.	259	10.2	285	1.8	9.1	*w* 15.2	73.9	3.6	163
35 55	50 00	E.	243	9.9	267	0.7	15.2	12.4	17.9	2.7	145
35 00	47 17	E. S. E.	144	5.5	152	0.9	0.0	*w* 16.9	82.2	1.7	112
33 06	45 00	S. E.	194	9.1	211	3.3	0.0	*w* 11.5	85.2	1.6	61
30 00	41 23	S. E.	263	14.7	301	3 3	13.9	*w* 19.1	63.7	5.6	151
27 00	40 00	S. S. E.	194	6.5	206	2.6	*w* 10.4	0.0	87.0	2.5	39
25 00	40 00	S.	120	9.4	131	3.4	5.1	5.1	86.4	0.0	60
20 00	37 46	S. S. E.	325	0.3	326	0.0	1.8	0.0	98.2	0.0	54
15 00	35 36	S. S. E.	325	0.8	327	0.0	*w* 4.4	0.0	95.6	0.0	23
10 00	33 29	S. S. E.	325	0.0	325	0.0	0.0	0.0	100.0	0.0	54
5 00	31 24	S. S. E.	325	0.5	325	0.0	*w* 4.8	0.0	95.2	0.0	42
Equator.	31 24	S. S. E.	300	0.6	302	0.0	*w* 5.2	1.7	93.1	3.4	115
			3708		3917						
S. 1 00	31 49	S. S. W.	65	2.1	66	0.0	*w* 9.9	0.4	89.7	0.0	264
1 27	22 00	S. S. W.	29	0.0	29	0.0	0.0	0.0	100.0	6.2	15
3 00	32 39	S. S. W.	101	3.3	104	0.0	*w* 16.7	0.0	83.3	0.0	12
3 51	33 00	S. S. W.	55	0.0	55	0.0	0.0	0.0	100.0	0.0	21
5 00	33 28	S. S. W.	75	0.0	75	0.0	0.0	0.0	100.0	0.0	6
6 24	34 00	S. S. W.	84	0.0	84	0.0	0.0	0.0	100.0	0.0	9
7 00	34 15	S. S. W.	39	14.2	45	0.0	*w* 48.9	2.4	48.7	0.0	41
7 00	33 30	E.	44	3.2	45	0.0	0.0	*w* 11.8	88.2	0.0	23
8 13	34 00	S. S. W.	79	32.0	104	13.0	*w* 52.2	0.0	34.8	0.0	23

In this month and near this route, the calms of the "Horse Latitudes" are most prevalent between the meridians of 40° and 45° and the parallels of 32° and 33° N. Between the meridians 25° and 30° the equatorial calms are most prevalent from 5° North to the Line, the greatest prevalence of calms being between 3° and 4° North. Between the meridians of 30° and 35° the equatorial calms prevail most between 3° and 5° N. Here they extend also a little to the South of the Line. In the main, the equatorial calms prevail as you go to the East. When you cross the Line to the West of 29° draw a line from the point of crossing to St. Augustine, and aim to keep to the eastward of it, and for this purpose take advantage of all slants.* This direction applies to every month. You should aim generally to make easting, when easting becomes necessary after crossing the Line, before crossing 7° South.

If you can cross 7° S. to the East of 34°, there will probably be no necessity of steering the East course as by the table. Observe that calms are seldom or never found along this route in this month, south of 1° S.

* Vide p. 345.

ROUTE TO RIO, ETC.—JUNE.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total.
			True.	Per Ct.	Average	Head.	SLANTS FROM N'd.	SLANTS FROM S'd.	Fair.	Calms.	
From	New York to										
39°11′	70°00′	E. S. E.	199	10.1	219	2.6	7.8	w 11.4	78.2	3.1	349
37 34	65 00	E. S. E.	254	13.4	287	5.3	w 10.7	4.0	80 0	1.3	300
35 55	60 00	E. S. E.	259	5.9	272	2.0	2.8	w 6.2	89.0	1.2	245
35 00	57 17	E. S. E.	144	8 8	157	2.2	6.3	w 10.9	80.6	0.9	233
34 13	55 00	E S. E.	123	2.0	125	0.0	w 10.0	0.0	90.0	20.0	20
32 30	50 00	E. S. E.	271	6.1	287	0.0	10.0	10.0	80.0	0.0	30
30 45	45 00	E. S. E.	276	5 8	292	1.1	2.1	w 17 0	79.7	19.7	94
30 00	42 54	E S. E.	118	19.3	140	6.7	17.4	16.0	59.9	9.7	149
27 28	40 00	S. E.	215	15.0	247	3.3	w 22.9	6.6	67.2	4.2	67
25 00	37 15	S. E.	209	16.2	242	6 0	w 13.0	9.0	72.0	4.8	100
20 00	35 00	S. S. E.	325	2.6	333	0.0	w 9.0	0.0	91.0	1.8	56
15 00	32 50	S. S. E.	325	0.3	326	0.0	0.7	0.9	99.1	0.8	116
10 00	30 43	S. S. E.	325	2.0	331	0.0	w 7.5	1.5	91.0	0.0	66
5 00	28 37	S. S. E.	325	17.6	381	5.3	13.2	13.8	67.7	16.0	152
Equator.	30 41	S. S. W.	325	8.8	353	2.8	w 16.1	2.8	78.3	0.0	106
			3693		3992						
S. 1 00	31 06	S. S. W.	65	3.0	67	0.0	w 12.0	0.0	88.0	0.0	171
3 00	31 06	S. S. W.	330	5.8	138	0.0	28.5	0.0	71.5	0.0	21
5 00	32 46	S. S. W.	130	10.0	143	0.0	50.0	0.0	50.0	0.0	12
5 34	33 00	S. S. W.	37	10.0	41	0.0	50.0	0.0	50.0	0.0	12
7 00	33 36	S. S. W.	93	7.7	100	0.0	33.4	0.0	66.6	0.0	21
7 58	34 00	S. S. W.	63	6.6	67	0.0	27.0	0.0	73.0	0.0	37
9 00	34 26	S. S. W.	67	6.4	71	0.0	24.0	2.0	74.0	0.0	50

If the wind should, as it probably will, head you off, after crossing the Line to the West of 30°, so as to force you to leeward of 33° before crossing 5° 30′ S., stand East for a few leagues, or until the wind hauls so as to let you lay up.

Aim to cross the equator near 29°; and do not, if it can be avoided, go to the east of 28° 30′ after crossing 10° N. The farther you go East there, the more prevalent are the calms.—Endeavor to cross 30° N. in about 40° W., so you may get to 25° N. by a South course. It is difficult to get to the S. E. between those two parallels. Southwest winds are not uncommon here. Between 10° and the equator, calms are much more frequent E. of 30° than to the West of 30°, and they become more prevalent as you go East. Between 25° and 30° W. from 3° to 5° N. are the calm latitudes in this month. See the Charts, Pilot and Track.

Vessels should aim never to get to leeward of the track here laid down after crossing the Line. The winds hang obstinately to the southward in June. Therefore take advantage of all slants for making easting in south latitude, until you get to 9° S. Don't consider yourself too far eastward, if in this month you cross this parallel in 31° W. No calms obtain in June, South of the Line, and between 29° W. and the coast. Among 1,000 observations examined in this part of the ocean, for this month, not one calm is recorded.

Between 65° and 70° W., 30° and 33° N., is a great place for calms—also from 25° to 28° N., between 60° and 65°. On the average you will carry the N. E. trades to 8° or 9° N.—Equatorial calms are most prevalent between 6° and 10° N., and 25° and 30° W. But between 30° and 35° W., the calms are most prevalent between 5° and 7° N.

Between 30° and 35° W., you sometimes get the S. W. monsoons, and you are liable to them from 9° to 1° N.

ROUTE No. 1, TO RIO, ETC., IN JULY—(For fast Vessels.)

Latitude.	Longitude.	Course.	DISTANCES. True.	DISTANCES. Per Ct.	DISTANCES. Average	WINDS; PER CENT. Head.	Slants from N'd or E'd.	Slants from S'd or W'd.	Fair.	Calms.	Total No. observ'ns.
From	Sandy Hook to										
29°11′	70°00′	E. S. E.	199	11.4	222	2.2	11.8	10.8	75 2	4.0	310
37 33	65 00	E. S. E.	256	5.4	269	0.2	8.2	6.5	85.1	10.7	411
35 54	60 00	E. S. E.	259	7.7	278	2.6	4.7	6.9	85.8	7.5	234
35 00	57 21	E. S. E.	141	5.3	148	0.4	4.7	w 7.9	87.9	3.4	256
34 12	55 00	E. S. E.	126	19.2	150	6.2	w 18.5	10.8	64.5	12.2	65
32 28	50 00	E. S. E.	272	20.6	297	7.2	9.6	w 22.8	60.2	0.0	84
30 00	50 00	S.	148	14.4	173	1 7	w 19.9	17.4	61.0	1.7	116
25 00	50 00	S.	300	10 6	352	5.3	w 10.5	0.0	84.2	5.0	19
20 24	45 00	S. E.	390	3.5	402	0.0	w 0.0	17 4	82.6	0.0	23
20 00	44 34	S. E.	34	5.1	36	0.0	w 18.0	0.0	82.0	0.0	28
15 40	40 00	S. E.	368	5.8	389	0.0	w 28.7	0.0	71.3	0.0	28
15 00	39 10	S. E.	57	11 5	57	0 0	w 1.4	0.0	98.6	0 0	72
10 48	35 00	S. E.	356	5.9	377	0.0	w 25.0	0.0	75.0	7.2	64
10 00	34 40	S. S. E.	52	6.4	55	1.0	w 8 2	1.0	89.8	5 8	98
8 06	30 00	E. S. E.	299	11.7	334	1.0	w 18.6	15.5	61.9	13.4	97
6 03	25 00	E. S. E.	322	14.2	367	2.4	15.6	w 18.0	64 0	10.7	167
5 00	25 26	S. S. W.	68	29.8	88	8.4	w 35.4	12.6	44.6		
Equator.	27 30	S. S. W.	325	7.4	348	1.3	w 21.9	0.0	76.8	0.0	78
			3972		4322						
S. 3 36	29 00	S. S. W.	234	6.9	348	2.0	w 21.0	2.0	75.0	0.0	401
4 36	30 00	S. W.	85	0.0	85	0.0	w 39.8	0.0	69.2	0.0	35
5 00	30 10	S. S. W.	26	2 9	27	0.0	14.2	0 0	85.8	0.0	21
5 50	31 00	S. W.	70	0.0	70	0.0	0.0	0 0	100 0	0.0	33
7 00	31 30	S. S. W.	76	5.0	80	0.0	24.9	0.0	75.1	0 0	12
7 30	32 00	S. W.	42	0.6	42	0.0	3.4	0.0	96 6	0.0	29
8 29	33 00	S. W.	84	2.9	86	0.0	14.4	0.0	85.6	0.0	21
9 00	33 51	S. W.	44	1.9	45	0.0	9.6	0.0	90 4	0 0	42
10 14	34 00	S. S. W.	80	7.2	86	0.0	26.0	0.0	74.0	5.0	39
11 00	34 19	S. S. W.	50	4.2	52	0.0	23.4	0.0	76.6	0.0	39

JULY TRACK TO RIO—NO. 1.

The difficulties for this month consist in calms and baffling winds in certain regions which it is necessary to avoid. I have therefore given two tracks for this month, viz: One for bold navigators and fast sailing vessels that can lay up within six points of the wind; and the other for dull sailers, that cannot do well close hauled. Both tracks avoid the calms of the Horse Latitudes.

There is not much difference between them as they are here given, in point of average sailing distance.—The difference consists in better working breezes by route No. 1 than the other, and I now confine myself to this route, viz: No. 1.

In taking this route, if you keep much to the East of the track, say between the parallels of 35° and 30° N., you will get into the calms of the Horse Latitudes—see by the Trade Wind Charts where these calms most prevail along this route, and at this season.

After reaching the meridian of 50° W., South is given as the course which a vessel will make on the *average* thence to the parallel of 25°.

But it should be recollected that the tracks given in these directions, and which every navigator who intends to be guided by them, is recommended to project on his chart, are in no case the track which the vessel herself is expected actually to make. Suppose a large number of vessels at different times should take this route as their guide, the mean of all their tracks would be represented by the route which I recommend; though perhaps it would not represent the track of a single vessel taken separately. Some would be on one side, some on another; some would cross it in one place and some in another.

It is difficult to get navigators to comprehend this. Many of them think that to go the routes recommended by me, they must actually run on the lines which I have drawn to serve merely as guides for them, and for the purpose of my own convenience in illustration.

Vessels that attempt to follow these routes will sometimes find themselves hundreds of miles on one side or the other of the track as projected, and when they find themselves so driven off from the track as laid down in the books, they should not attempt to get back upon the line itself as though it were a channel way, but taking the direction in which it lies as a guide, and consulting the charts with which they are supplied, they should shape their course and be governed accordingly.

Every track that I have drawn shows that head winds may be expected along it, and when these head winds are encountered, the vessel so encountering must expect to be turned aside, and whether she should beat or not, or stand off altogether upon this or that tack, the master must decide, and he should be governed in his decision by the sailing directions and the charts themselves.

With this general explanation for *all* the routes, navigators who try this July route will perceive that I do not recommend that they should, after reaching the meridian of 50° W., actually stretch away due South for 500 miles until they reach the parallel of 25° N., where the wind will allow them to lay up to the southward and eastward.

Suppose that a vessel on this route should, on reaching the meridian of 50° near Lat. 32° 28′, have the wind to come out from S. E.—as she will find it to do on the average 12 times in 100—she should not in this case stand to the northward and eastward, because she would then run up into a part of the ocean where the calms and light airs of the Horse Latitudes are most vexatious. If she could not lie south, she should stand down to the southward and westward until the wind hauls, or until she should reach the parallel of 31°, and then go about, taking care not to recross the parallel of 32° to the west of 45°.

After crossing 30° N., strive not to fall to the westward of the projected track. Consider yourself in the best possible position if you can cross the parallel of 25° N. between 40° and 45°, or the parallel of 20° between 35° and 40°. From either of these positions you will have no difficulty in reaching the meridian of 30° or 31° between the parallels of 9° and 12° N., where you will lose the N. E. trades, you will then take the equatorial calms, and they may hang on you obstinately, *if you go much further to the East;* but you will seldom or never carry them with you below 6° N. Cross 6° N. by the shortest possible course. Losing these calms, you will

generally get the S. E. trades; for to the west of 30°, the S. W. monsoons seldom blow—though they do sometimes; to the east of 30° they blow quite constantly in July. To the east of 30°, the equatorial calms prevail from 15° N. to 8° N.; and you will be liable to the S. W. monsoons from 11° to 2° N. Hence you will observe that it is important you should, if the winds will allow you, cross the equatorial "doldrums" about 30° W., and not go further east than 27° if you can possibly avoid it.

After crossing the Line and getting the S. E. trades, if you should find yourself unable to clear the land, stand on boldly to the southward, unless the wind should slant so as to allow you to lay well up to the eastward on the other tack, until you cross 5° S. to the west of 33°. Between this parallel and 9° S. you can make either a south or an east course good on the average twice out of three, and in some regions three times in four; or even when you get near the land, four times in five. It is better to take the chances of these slants than it is to attempt to make your easting in the "doldrums" north of the Line. If a vessel strike these calms to the east of 27° west, she may consider herself lucky if she gets clear of them in less than a week or ten days. Don't fear to pass west of Fernando de Noronha.

July is an unfavorable month for quick passages, let a vessel take what route she will.

ROUTE NO 2, TO RIO, ETC., FOR JULY.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			Direct.	Per Ct.	True.	Head.	SLANTS FROM		Fair.	Calms.	
							Nd. or Ed.	Sd. or Wd.			
From	Sandy Hook to										
39°11′ N.	70°00′	E. S. E.	199	11.4	222	2.2	11.8	10.8	75.2	4.0	310
37 33	65 00	E. S. E.	256	5.4	269	0.2	8.2	6.5	85.1	10.7	411
37 33	60 00	E.	238	9.0	259	3.4	w 8.6	5.2	82.8	7.5	234
37 33	55 00	E.	238	9.0	259	4.3	3 5	w 6.3	85.0	3.4	256
37 33	50 00	E.	238	6.7	254	1.1	4.9	w 9.0	84.1	5.8	262
37 33	45 00	E.	238	8.2	257	2.9	1.2	w 10.2	85.7	2.8	243
35 54	40 00	E. S. E.	259	5.9	274	1.6	2.0	w 11.1	85.3	3.3	244
35 00	38 54	S. E.	77	14.9	88	3.6	9.0	w 19.5	67.9	5.5	329
31 41	35 00	S. E.	274	9.6	300	1.0	w 16.0	10.0	73.0	3.8	100
30 00	34 09	S. S. E.	115	6.2	122	0.0	w 17.6	11.0	71.4	8.3	46
25 00	31 49	S. S. E.	325	8.5	352	3.0	7.0	8.0	82.0	3.0	98
21 00	30 00	S. S. E.	260	0.3	261	0.0	1.5	0.0	98.5	0.0	130
20 00	29 34	S. S. E.	65	0.3	65	0.0	0.0	2.1	97.9	1.4	142
15 00	27 24	S. S. E.	325	0.5	327	0.0	2.5	0.0	97.5	1.8	163
10 00	25 17	S. S. E.	325	4.3	339	0.6	w 8.2	5.2	86.0	9.2	158
	Thence	S. or S. S. E.	to inter	section	of track	No. 1.					

This route is intended for dull sailers and timid navigators. Do not cross 35° N., to the west of 45°; nor 33° N., to the west of 40°. After crossing 30° N. in about 33°, you have, as the track shows, all the chances nearly of fair winds in your favor, until you get between 13° and 8° N.; between which parallels, if you be between the meridians of 25° and 30°, you may expect to lose the N. E. trades, and then to contend with southerly winds, light airs and calms, (if between these two meridians,) till you get between 5° and 2° N., where the S. E.

trades will be found. The getting from the N. E. into the S. E trades is the difficult part of the passage, and the farther you go east, the more difficult this is. In July you can carry the N. E. trades two or three degrees farther down by keeping between the meridians of 30° and 35°, than you are liable to do between the meridians of 25° and 30°. In like manner you will get the S. E. trades further to the north between the two former, than you will between the two latter meridians. And in this fact is the great secret of the advantage to be gained by keeping tc the west.

ROUTE TO RIO, ETC., FOR AUGUST.

Latitude.	Longitude.	Course.	DISTANCES.			WINDS; PER CENT.					Total No. observ'ns.
			Direct.	Per Ct.	True.	Head.	SLANTS FROM Nd. or Ed.	SLANTS FROM Sd. or Wd.	Fair.	Calms.	
From	Sandy Hook										
39°11′	70°00′	E. S. E.	199	12.3	223	3.0	13.2	11.4	72.4	5.4	366
37 33	65 00	E. S. E.	256	9.8	281	3.2	5.0	*w* 10.3	81.5	3.5	221
35 54	60 00	E. S. E.	259	8.0	280	2.2	5.4	*w* 9.7	82.7	4.1	185
35 00	57 20	E. S. E.	141	10.9	156	4.6	3.9	*w* 7.8	83.7	7.2	154
33 04	55 00	S. E.	165	8.5	178	1.9	*w* 11.4	3.8	82.9	3.6	53
31 19	50 00	E. S. E.	275	9.6	302	2.6	10.4	*w* 13.0	74.0	0.0	76
30 00	46 17	E. S. E.	207	15.2	238	4.6	9.2	*w* 25.3	60.9	6.5	43
29 32	45 00	E. S. E.	72	39.2	100	8.0	*w* 48.0	28.0	16.0	7.4	25
25 00	42 54	S. S. E.	294	6.4	312	1.5	*w* 19.1	0.0	79.4	2.9	68
22 21	40 09	S. E.	225	7.7	242	0.0	*w* 16.8	7.2	77.0	6.7	42
20 00	38 57	S. S. E.	153	4.8	160	2.0	*w* 8.0	0.0	90.0	0.0	49
15 00	36 47	S. S. E.	325	7.0	347	3.7	*w* 5.5	0.0	90.8	0.0	54
10 50	35 00	S. S. E.	271	8.5	294	2.8	*w* 8.6	4.7	83.9	7.1	105
10 00	34 38	S. S. E.	54	11.5	60	3.4	*w* 11.1	6.6	78.9	9.0	90
8 06	30 00	E. S. E.	297	8.0	320	0.0	8.8	*w* 15.8	75.4	8.1	57
5 00	26 53	S. E.	263	4.6	275	0.0	4.4	*w* 15.9	79.7	7.4	114
Equator.	28 57	S. S. W.	325	10.1	358	1.3	*w* 35.1	0.0	63.6	1.2	78
			3,781		4,126						
1 00 S	29 22	S. S. W.	65	1.4	66	0.2	4.5	0.3	95.0	0.0	402
2 32	30 00	S. S. W.	99	5.7	105	0.0	28.5	0.0	71.5	0.0	21
3 00	30 12	S. S. W.	30	13.3	34	0.0	66.6	0.0	33.4	0.0	9
5 00	31 00	S. S. W.	130	6.7	139	0.0	33.3	0.0	66.7	0.0	18
7 00	31 50	S. S. W.	130	0.0	130	0.0	0.0	0.0	0.0	0.0	18
Thence	*ad lib.*										

The only precaution to give with regard to this route—for in August the passage is liable to be tedious by any route—is not to cross the meridian of 50° W. to the North of 31°, or to the South of 29° N.

After reaching the meridian of 35° between the parallels of 11° and 10° N., stand straight as the winds will allow for the equator in about 29° or 30°, not caring if you fall upon the Line as far as 30° W. After getting the S. E. trades in this month, there is no difficulty in making stretches to the East; for the S. E. trades frequently at this season of the year blow from S. S. E., and if navigators will bear this fact in mind they should not be discouraged if the wind should force them to cross the equator as far West as 35°: some have even crossed in 41°, and made good passages by taking advantage of slants South of the Line to make easting with. But of course no navigator would willingly cross so far to the westward as Longitude 40°.

Vessels from ports South of the Capes of Virginia, that intend to try this route should run up to 34° and continue between the parallels of 34° and 35° until they fall in with the route as projected, which they will do somewhere between the meridians of 55° and 60°. This they are recommended to do on account of the calms of the "Horse Latitudes," with which, by keeping South of 34° in this season and part of the ocean, they are liable to be bothered.

In August, if between the meridians of 30° and 35°, expect to lose the N. E. trades from 14° to 10° N.; to have the equatorial calms from 13° to 9° N.; and the S. W. monsoons occasionally *only* from 12° to 5° N.

Between the meridians of 25° and 30° W., the N. E. trades are sometimes lost in 17° N., generally in 12°, though they are occasionally carried to 9°; seldom below. The calms prevail from 15° to 8° N., and the S. W. monsoons with considerable regularity from 14° N. to the equator. That is, you are liable to get them somewhere between 14° N. and the equator, as you are liable to encounter the calms and to lose the N. E. trades between the parallels above stated.

ROUTE TO RIO, ETC., FOR SEPTEMBER.

Latitude.	Longitude.	Course.	DISTANCES. Direct.	Per Ct.	Average.	WINDS; PER CENT. Head.	SLANTS FROM Nd. or Ed.	Sd. or Wd.	Fair.	Calms.	Total No. observat'ns.
40°27′	70°00′	E.	186	13.0	210	2.5	*w* 17.0	*w* 14.0	66.5	3.4	200
38 52	65 00	E. S. E.	249	9.9	274	2.2	*w* 12.4	7.5	77.9	5.1	184
37 14	60 00	E. S. E.	256	7.4	275	0.7	*w* 12.6	7.7	79.0	3.3	447
35 35	55 00	E. S. E.	260	7.4	279	1.6	8.8	7.2	82.4	4.0	123
35 00	54 18	S. E.	48	25.3	60	9.4	13.7	*w* 16.6	60.3	3.5	139
33 31	50 00	E. S. E.	232	15.0	267	3.0	3.0	*w* 42.0	52.0	0.0	34
31 47	45 00	E. S. E.	272	15.4	313	6.0	4.0	*w* 22.0	68.0	5.7	50
30 00	42 55	S. E.	151	15.0	174	2.9	11.5	*w* 21.7	63.9	4.2	69
27 27	40 00	S. E.	217	17.9	255	2.8	11.2	*w* 25.2	60.8	2.7	36
25 00	37 16	S. E.	208	16.8	243	3.4	17.9	16.8	61.9	1.1	89
20 00	37 16	S.	300	4.2	313	4.2	*w* 10.5	0.0	85.3	2.6	38
15 00	35 06	S. S. E.	325	0.0	325	0.0	0.0	0.0	100.0	0.0	23
10 00	32 58	S. S. E.	325	7.8	349	1.6	*w* 11.3	9.8	77.1	6.1	61
8 47	30 00	E. S. E.	191	16.8	223	2.8	3.6	*w* 30.8	60.8	4.0	73
5 00	27 11	S. E.	321	18.4	380	5.8	9.6	*w* 23.0	61.6	7.1	104
*Equator.	29 15	S. S. W.	325	14.1	370	6.2	*w* 34.3	1.4	58.1	0.0	70
			3866		4310						
1 58	30 00	S. S. W.	118	17.4	138	4.4	*w* 13.3	5.7	58.6	0.0	297
3 00	31 02	S. W.	88	9.6	96	0.0	*w* 48.2	0.0	51.8	0.0	27
5 00	31 52	S. S. W.	130	12.5	145	0.0	*w* 62.5	0.0	37.5	0.0	24
5 19	32 00	S. S. W.	21	3.4	22	0.0	*w* 16.7	0.0	83.3	0.0	12
7 00	32 42	S. S. W.	108	7.2	115	0.0	*w* 35.7	0.0	64.3	0.0	14
7 43	33 00	S. S. W.	47	1.3	48	0.0	*w* 6.0	0.0	94.0	0.0	17
9 00	33 32	S. S. W.	83	8.0	91	0.0	*w* 36.6	0.0	63.4	0.0	30

It may be said that the N. E. trade winds prevail in September and October only to the east of longitude

* The best routes for October and November do not differ materially from those for September and December. See Pilot Chart.

50°, and then only between the parallels of 15° and 25° N. They sometimes blow in other parts of the ocean, but it cannot be said that they *prevail*.

Endeavor to cross the meridian of 50°, in September and October, before you do the parallel of 30° N., and do not consider yourself hopelessly to leeward, if you be *forced* to cross the parallel of 20° N., as far west as longitude 45°, or the parallel of 10° N., as far as 36° or 37° W., for in September and October, as the Pilot Charts show, you may frequently meet, between 10° N. and the Equator, the S. E. trade winds.

The S. E. trades may be calculated on with certainty between 7° N. and 13° N., between 35° and 40° W. Occasionally the S. W. monsoons are found between the same parallels. The S. E. trades, when taken in the northern hemisphere in this month, are frequently at S. S. E.; and therefore it is not difficult for vessels that find themselves as far West as longitude 37° in latitude 10° N., to get to the eastward before crossing the Line.

Between Long. 30° and 35°, the equatorial calms are found from 4° to 12° N. and between Long. 25° and 30° they, and the S. W. monsoons, are found from 12° to the equator; and as a general rule they are found more and more vexatious as you go east.

Captain Sinclair, when in command of the U S. Frigate "Congress," on her way to South America, with that close observation of all the phenomena about him which gives a particular value to his remarks, observed the difficulties of crossing this belt far to the eastward. He crossed it in January, 1818, and inferred that there was a belt of monsoons between the two trades. He was mistaken as to the time of the year. He crossed this belt in January, and though in January the winds are sometimes from the S. W., yet at that time of the year, they have nothing of the character of monsoons about them.

I quote a passage from his Journal:

"We made a great run from their latitude (the Cape de Verdes,) to about 7° 30′, when the N. E. Trade began gradually to leave us, which it did effectually before we reached the latitude of 6° 30′ North, having run from 19° 30′, a distance of near 900 miles, between the 31st December and the 5th January, and from this time to the 17th there was little else than a continued calm, except when occasionally disturbed by a thunder squall and violent rains. Though considering we were at one time as far East as Long. 19° W., we had very little rain and very few squalls of wind; those we had were principally from S. S. W. to W. S. W.; indeed there appears to be between the N. E. and S. E. Trade winds which we found to be from 6° 30′ North to the equator, a light monsoon from the S. W."

Had this remark been made in the summer instead of the winter it would have been perfectly correct.

If after getting within these latitudes, *i. e.*, those in which the calms are mentioned as prevailing, and the wind should come out at S. E., prefer the port tack; for before you make the land, you are almost sure to have the wind out from the S. S. E., when you can make your easting within the regions of the perpetual S. E. trades.

After getting the S. E. trades, and finding himself a little pinched for easting to clear the land, the skilful navigator will see that by standing on with the wind at S. E., all the chances are in his favor. If the wind

haul to S. S. E., he can go about and make easting. If it veer to E. S. E., or further, he can lay up and clear the land; for whether you go this or that side of Fernando da Noronha in this or any other month, is a matter of no sort of consequence, excepting only so far as the difference of longitude is concerned. If you can weather it, do so, but do not waste time simply that you may pass to the eastward of it.

Good passages are sometimes made in September, but, as a general rule, the most tedious seasons of the year, are the summer and fall months for passages.

After losing the N. E. trades, the navigator may consider himself fortunate in this month if he is not baffled about for more than a week before he gets the S. E. trades.

From Capt. Samuel Very, Jr.—to Lieut. M. F. Maury.

RIO DE JANEIRO, *January* 30*th*, 1852.

"I herewith forward the abstract log of the "Hurricane," from New York to this port (Rio.) You will perceive that I lost my topmasts, and all, about the 17th day out, and that I had nothing but 3 courses, mizzen top-sail and spanker for three days after, with calms and faint airs from E. S. E., and for 9 days I had no fore top-sail, jib or top-gallant sails set. Neither did I have the wind North of E. by N. afterwards. However, I crossed the Equator in 33° 40′ West, 26 days from New York, and have had no trouble in getting by St. Roque, not going East of 33° 20′ on the passage. From the Equator to Rio, I had the poorest chance I have ever known, not having a day without at least 4 hours calm, till South of 20° S. The abstracts of the remaining passages, I may make in the prosecution of this voyage, I shall forward from the different ports upon my arrival."

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*General Remarks on the passage from the United States to Ports beyond the Equator.**

It has now [January, 1853,] been about six years since I first proposed a new and shorter route hence to the equator, for all vessels, whether bound around the Cape of Good Hope, Cape Horn, to Rio, or to any of the ports of South America. The tracks of all such is the same until Cape St. Roque be cleared.

The W. H. D. C. Wright, (Jackson) of Baltimore, was the first vessel to try the new route. In 24 days from Hampton Roads, she crossed the Line in 31° W., and had a passage of 13 days thence to Rio. This was in February, 1848.

In May, she went out again, had 33 days to the Line, which she crossed in 33° 41′ W. In 3 days after she cleared St. Roque. On this passage she was detained 6 days by calms between 8° 30′ and 5° N. But she had no difficulty, it will be observed, in weathering Cape St. Roque. This trip, it took her 11 days to clear the equatorial calms, which she found between 9° N. and 3° N.

* Originally submitted in 1849.

In the spring of 1849, she went out again. She had 32 days to the Line in 28°, after having been delayed 9 days by calms between 5° N. and the Line, whence, in 3 days, she again cleared Cape St. Roque. The average therefore of Capt. Jackson's passages to the Line, by the New Route, was 30 days, against 41 by the Old Route.

The "Chicora," the "Helena," and the "Midas," tried this route about the same time, and all with equal success; their average to the Line being 26 days only.

These practical demonstrations of the advantages of the route which I had pointed out were not wanting to satisfy me of their value, for I had consulted many thousand records as to the winds encountered in this part of the ocean by different vessels on different occasions. These records show the number of times on which the winds had been found to blow from each point of the compass in different parts of the ocean. And knowing the prevailing winds for each 5 degrees square, the navigator could tell what course it was practicable for a vessel to steer through these squares, as well before as after the trial had actually been made.

For instance, in a certain square of 5 degrees, I obtained the records of 700 vessels during the month of August in different years. Vessels bound South by the old route, were in the habit of passing through this square, always aiming to make a S. S. W. or south course through it. And of these 700 records as to the wind, 600 gave the wind directly ahead for the South or S. S. W. course. To convince any one, then, who believes in the records examined, that a vessel in this part of the route to Rio would *generally* find the winds ahead, did not require that a vessel should be sent there actually to try it, for here was the experience of 700 vessels, 600 of which had found the winds adverse for a southerly course.

But certain navigators were not disposed to look upon my investigations in this light. Forgetting that they were the results of actual observations, these persons were disposed to consider those results thus announced, as theories, or matters of opinion of my own; whereas they are no more matters of opinion than is the fact that the trade winds blow is a matter of opinion. They are nothing more nor less than the sum of the experience of some thousands of navigators, as to winds and calms.

The effect has been, that though many shipmasters have at once perceived the bearing of these results, and the correctness of the conclusions derived from them, and have readily adopted them, still others have rejected them altogether, or only partially adopted them.

It has not unfrequently happened, as I perceive by the Log-books returned to me, that a navigator will put to sea and stand boldly out for the new route. But after awhile, the wind comes out ahead. He then gets frightened, abandons it, has a long passage, and lays the blame to the new route.

I have never claimed for any of these routes an exemption from liability to head winds. On the contrary, I expressly show that a vessel by any of the routes proposed by me is liable both to head winds and calms; and not only so, I have shown the chances of both against her.

I may here remark that I have never yet heard of a navigator complaining of the new route and a long passage by it, but what, when his abstract Log came to be examined, it did not appear that the fault was quite as much with him as with the route. For instance, I have drawn certain lines or tracks to show the route

recommended. These lines are intended to show the route that vessels should take, not the *track* that they should make. Vessels taking such routes, should be guided by these lines as to the general direction which they ought to pursue. It was never intended that, with fair winds, they should make the zig-zags of these lines. But some navigators have inferred that there was virtue in these lines themselves; that they must be followed as rigidly and as closely as though they marked out a channel-way, on either side of which if a vessel should fall, she would find herself in difficulty. Accordingly, abstracts that have been returned to me show frequent instances wherein vessels, after having been headed off from the projected track, have had the winds perfectly fair for pursuing their straight course onward, yet they have nevertheless proceeded to make a head wind of such, and to beat back out there on the open sea, for the purpose of getting back on the track projected.

Suppose that ship A, makes an uncommonly quick run to a given port, and that she gives her track to B; B attempts it, but is headed off. Now B from this new position will not attempt to go out of his way to get actually in the wake made by A; but B will shape his course by that of A and run by it; and consider that he is following it, when he is near it. This is what I wish vessels to do with regard to the routes that I have projected for them. Do not go out of your way to get on those tracks, but consider yourself, unless especially directed otherwise, to be in good position when you are within one or two hundred miles of the projected track according to the quantity of sea-room.

Therefore, when you are *near* the projected track, consider yourself in as good a position as though you were actually on it.

For the purpose of affording navigators and ship owners an opportunity of comparing the new and the old routes together, and of drawing their own conclusions as to the advantages of the routes recommended by me, Professor Flye has taken at random, and just as they came to hand, a number of tracks by each route, and has stated those for the several months in the tables below.

It should be borne in mind that this showing, though greatly in favor of the new routes, is not as much so as it will probably be after navigators shall come to understand them better, and to have more confidence in them.

Several vessels are put down under the new route, which pursued it to the equatorial calms, became fearful of falling to leeward, abandoned it and ran over to the eastward to fall in with the old beaten track; and had long passages. The cases of such will be mentioned under the head of remarks for the several months. Though there is reason to believe that their passages were considerably prolonged in consequence of thus abandoning the new route, yet they are counted as among the vessels that have tried it, because of my desire not to *overstate* the advantages of the new route. I prefer to err, if it all, on the safe side.

COMPARISON OF PASSAGES BY THE NEW AND BY THE OLD ROUTE TO THE LINE.

FOR JANUARY.

NEW ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Ship Chicora	1848	Jan. 21	Boston to Canton . . .	26	27°00′W	29
Schooner Boston . . .	1849	27	Boston to California . .	32	30 00	35
Ship Montreal	"	27	Boston to Sand'ch Isl'ds	24	30 20	27
Brig New Castle . . .	"	5	Boston to California . .	38	26 40	44
Bark Ocean Bird . . .	"	5	New York to California	38	25 30	44
Ship Aurora	"	9	Nantucket to California	35	24 00	41
Pilot Boat Anonyma . .	"	18	Boston	25	29 40	28
Bark Isabelita Hyne . .	1850	27	N. York to Pernambuco	27	30 00	29
U. S. Store Ship Supply	"	3	New York to Rio . . .	35	33 00	40
Bark Agnes	"	2	New York to Rio . . .	32	27 00	34
				312	283.10	351
			Mean	31.2	28.31	35.1

OLD ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Don Juan	1843	Jan. 16	Boston to China . . .	33	22°31′W	37
New Jersey	"	18	Salem to Manilla . . .	31	22 30	36
Recovery	1802	15	Salem to Sumatra . .	27	23 07	31
New Jersey	1842	26	Boston to Calcutta . .	26	17 33	31
Tyber	1839	25	Boston to New Holland	38	22 36	43
Clifford Wayne . . .	1835	22	Boston to Rio	25	20 36	35
Elizabeth	1841	13	Salem to South Sea . .	41	21 00	44
				221	149.43	257
			Mean	31.6	21.23	36.7

There is less difference between the two routes in this month than at any other season—still there is a decided gain. The mean longitude in which the vessels crossed the equator, was, by the new route, 28° 31′, by the old 21° 23′. But the time thence to clear Cape St. Roque, is by the new route 3.9 days, against 5.1 by the old, or a total gain of one day and a half by the new route.

Three of those vessels by the new route departed from instructions when they got near the equatorial calms and went to the east of Long. 27°. These vessels were the New Castle, the Ocean Bird, and the Aurora. They had, severally, to the Line, 38, 38, and 35 days. Now, if we exclude these as vessels which, according to their log, did not stick closely to the new route, the average January passage would be brought down to 28.7 days to the Line, and 31.7 to clear Cape St. Roque, which would show a gain of 5 days in favor of the new route, for this month. And this gain I expect will be realized.

FOR FEBRUARY.

NEW ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Ship Helena	1848	Feb 15	New York to Canton .	23	27°58′W	26
U. S. Ship Marion . .	1850	27	Boston to Canton . . .	28	30 00	31
W. H. D. C. Wright .	1848	9	Baltimore to Rio . . .	24	31 03	27
				75	89.01	84
			Mean	25	29.40	28

OLD ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Toulon	1845	Feb 11	New York to Valparaiso	37	21°19′W	39
Essex	1802	19	Salem to Calcutta . .	44	19 39	51
Coriolanus	1844	17	Boston to Buenos Ayres	35	23 09	41
Metamora	1840	12	Boston to Buenos Ayres	33	25 00	37
Cadet	"	20	Boston to Montevideo .	34	22 30	38
			Mean	183	111.57	206
				36.6	22.23	41.2

The mean longitude in which these vessels crossed the equator, is 29° 40′ for the new, and 22° 23′ for the old route. The average time required to clear Cape St. Roque after crossing the Line, is 4.6 days by the old, and 3 days by the new route. Thus exhibiting a mean gain of 13.2 days in favor of the new route, in this month, and no difficulty as to clearing the land from a point as far as 30° W. on the equator.

February is one of the best months for short passages.

FOR MARCH.

NEW ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Schooner Midas . . .	1848	Mh. 10	Savannah to Rio . . .	28	28°05′W	32
U. S. Ship Savannah .	1849	2	Boston to Rio	23	29 50	31
Bark Kirkland	"	7	Baltimore to Rio . . .	21	34 28	29
Ship Helena	"	11	New York to Rio . . .	19	41 30	26
Bark Mason Barney . .	"	20	N. York to Buenos Ayres	37	29 30	39
Bark W. H. Shailer . .	"	18	Boston to Tahiti . . .	37	28 15	40
				165		197
			Mean	27.5		32.8

OLD ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Sarah	1846	Mh. 18	Boston to Madras . .	46	18°43′W	49
Medora	1845	31	Boston to Manilla . .	43	23 00	45
Dawn	1825	4	Eastport to Brazil . .	40	20 00	44
Clifford Wayne . . .	1833	4	Boston to Batavia . .	43	23 18	49
				172		187
			Mean	43		46.7

In March we have six trips by the new, and four by the old route. The mean place of crossing by the former is 31° 56′, by the latter 21° 15′. Here the new route leads the old 15½ days to the Line.

The Helena fell to leeward, steered North and recrossed the equator in 37° W. From this longitude she was clear of Cape St. Roque in three days, and made the passage from New York to Rio in 34 days.

FOR APRIL.

NEW ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Bark Isabelita Hyne .	1848	Ap. 29	New York to Rio . . .	27	29°17′W	29
Bark Chalcedony . .	"	22	New York to B. Ayres .	60	31 59	64
Ship Deucalion . . .	"	7	Boston to Callao . . .	23	33 25	34
Ship Horsburg	"	5	Boston to Hong Kong .	24	29 30	26
Brig R. de Zaldo . . .	1849	19	Richmond to Bahia . .	38	27 00	40
Bark Hazard	"	4	Boston to Batavia . .	22	25 39	24
Ship Washington Allston	1848	21	Boston to Calcutta . .	29	28 00	32
Ship Houqua	1849	6	New York to Canton .	20	25 08	22
Ship Horsburg	1850	13	New York to Canton .	28	30 00	34
Ship Tartar	1849	3	New York to China .	23	25 00	25
Ship Memnon	"	11	New York to California	19	28 45	21
				315		351
			Mean	28.6		31.8

OLD ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Sirene	1845	Ap. 12	Philadelphia to B. Ayres	30	27°00′W	33
Mary Chilton	1839	17	New York to Rio . . .	36	27 00	38
Tuscaloosa	1829	22	Baltimore to Montevideo	35	25 36	38
Potomac	1838	3	Newburyport to Batavia	35	22 00	37
Telemachus	1802	21	Salem to Arabia . . .	43	24 12	46
Metamora	1841	7	Boston to Buenos Ayres	45	24 11	50
				224		242
			Mean	37.3		40.3

In April, we have for comparison six tracks by the old and eleven by the new route, with an average saving of more than a week in favor of the latter; notwithstanding the bad luck of the "Chalcedony." That vessel, when she got to the equatorial calms, committed the mistake of going too far east. She went as far as 24° and was 32 days in the "doldrums," between latitude 2° and 6° N. This is the longest passage, of which I have received any account, by the new route. It might be rejected because of the departure from this route in going so far to the eastward, but this is a mistake which navigators, I find, are liable to make; and, therefore, I have preferred to count it. On the other hand, if extraordinary long passages by the old route had been sought for, they might have been found of more than 100 days in length.

So, too, with the Brig R. de Zaldo. She was becalmed for 13 days in the "Horse Latitudes," between latitude 34° and 36° N., and 5 days in the equatorial calms, between 4° N. and the Line; also, the "Washington Allston." She went as far as 22° W., and was seven days becalmed in the equatorial "doldrums," between 5° N. and the Line.

Now, if these vessels, with the light southerly winds, which they met after losing the N. E. trades, had not been afraid of falling to leeward, so as not to weather Cape St. Roque, they no doubt would have done much better.

Instead of running obliquely, say an E. or an E. S. E. course along the equatorial calms, they should have endeavored to beat due South across the Line, so as to get clear of them in the least time possible. By fanning along to the eastward, they got into that part of the ocean where these calms are most obstinate.

If, therefore, we omit these three vessels from the count, as not coming justly within the rule, we shall have a difference of 13 days in favor of the new route for this month. But retaining them, there is still a difference of more than a week in favor of the new route for April.

☞ The new route is much less liable to calms than the old.

FOR MAY.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Schooner Wilmington .	1848	My.23	Baltimore to Bahia . .	45	27°54′W	48
Bark W. H. D. C. Wright	"	27	Baltimore to Rio . . .	33	33 41	36
Ship J. Q. Adams . .	"	30	Boston to China . . .	28	29 00	31
Ship Tonquin	"	11	Boston to Madras . . .	36	30 00	30
Brig Smyrna	1849	14	Boston to Cape Town .	50	21 00	53
Ship Tzar	"	12	Boston to Honolulu . .	33	24 00	36
Ship Montauk	"	12	N. Y. to Van Diem's L'nd	27	29 00	29
Ship Milton	"	22	Boston to Madras . . .	31	31 10	33
Ship Siam	"	2	Boston to Manilla . .	27	29 00	29
Ship Oneida	"	24	New York to Canton .	31	29 16	33
				341		367
			Mean	34.1		36.7

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Unicorn	1843	My.13	Boston to Manilla . .	39	25°00′W	41
St. Paul	1840	29	Salem to Manilla . . .	39	25 00	41
Albion	1838	26	New York to China . .	43	23 50	46
Albion	1839	10	New York to China . .	40	25 00	42
Chalcedony	1835	7	Boston to Cape G'd Hope	34	24 51	36
Abigail	1842	23	Boston to Pacific . . .	40	22 00	43
Harriet	1822	21	Baltimore to Lima . .	51	27 50	54
Ann	1823	21	Salem to Sumatra . .	54	26 06	57
				340		360
				42.5		45.

For this month, we have the means of ten tracks for the average for the new, and eight by the old routes.

I have nothing to say about the schooner "Wilmington," except that she appears to have had bad luck, as vessels by every route will occasionally have. She was becalmed 9 days between the parallels of 5° and 7° North.

The brig "Smyrna," after getting down to the region of equatorial calms, departed form the new route and went as far as 17° 30′ W., where she was fighting with calms and baffling airs for 13 days, for that is the time it took her to get from 9° to 2° North.

Yet notwithstanding all this, the average of all their passages by the new route, counting the "Smyrna," which went part of the way only by the new route, is 8.4 days less than by the old.

If we exclude the "Smyrna" from both, the new route would show a gain on the average of 10 days for May.

FOR JUNE.

NEW ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Bark Ann Hood . . .	1848	Jun. 22	New York to Rio. . .	37	32°00′W	40
Ship Samuel Russell .	"	2	New York to Canton .	22	24 27	24
Ship Charleston . . .	"	3	New York to Callao. .	36	27 17	38
Bark Saxonville . . .	"	4	Boston to Calcutta . .	35	23 25	37
Ship Prince de Joinville	"	18	New York to China. .	39	23 15	42
Bark Channing . . .	"	4	New York to Rio. . .	37	28 30	40
Ship Vancouver . . .	"	23	Boston to Canton. . .	28	27 47	30
Bark W. H. D. C. Wright	1849	23	Baltimore to Pernambuco	32	28 00	34
Cleora.	1848	11	Boston to Rio	30	28 48	33
France	"	4	New York to Rio. . .	38	28 34	40
				334		358
			Mean	33.4		35.8

OLD ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Niantick	1844	Jun. 5	Sag Harbor to Pacific .	46	19°00′W	49
Sartelle.	1847	7	New York to China. .	57	24 90	60
Ronaldson.	1844	7	New York to Canton .	35	27 00	37
Oscar	1842	19	New York to China. .	34	33 00	37
Oscar	1843	11	New York to China. .	36	24 00	38
Emerald	1827	7	Boston to Calcutta . .	37	20 30	40
Mars.	1829	16	Boston to Calcutta . .	39	24 00	42
Carolina	1844	2	Salem to India . . .	45	24 04	48
Jassore	1835	6	Boston to Batavia . .	45	28 00	47
				374		398
			Mean	41.5		44.2

In the month of June, vessels are recommended to go, under certain circumstances, as far East as 28°, and to cross the equator in about 30° W. See the route for Rio for that month, p. 352.

The mean crossing place of these ten vessels, whose tracks are given, is in Long. 28° 50′ W. on the equator. By the old route it is, for the mean of 9, in 23° 44′, or 5° further East.

The shortest way generally of clearing the equatorial calms, is to go straight across them by a North or South course In their belt, the light airs that blow are *really* baffling winds which, for the most part, are from the southward. As you go East, this belt of calms grows wider, and therefore the more difficult is it to be crossed.

As a general rule, when a vessel gets into this region of light airs and calms, she should always prefer that tack on which she can make the most southing. It is evident from the direction in which this calm belt lies, that a vessel that attempts to fan along to the eastward in it, is not only making no progress in crossing it, but that she is running along its length, and therefore prolonging her stay in it.

Vessels bound to South America and attempting the new route in June, are recommended not to go farther East in the calm belt, if it can be avoided, than Long. 28° W.

The vessels whose passages are longest for June, followed the new route till they lost the N. E. trades; and then for fear of falling to leeward, abandoned it, and went running along to the eastward in the belt of equatorial calms—whereby they no doubt considerably prolonged their passages. Thus the "Ann Hood," the "Charleston," and the "Channing," went as far as 23° W., and they were delayed, severally, 16, 10 and 8 days in crossing the calm belt. The "Saxonville" and "Prince de Joinville" went as far as 16° W., and were delayed, the former 11, and the latter 8 days, in consequence of prolonged calms and baffling winds.

Yet, notwithstanding the bad luck which thus prolonged the sum total of their passages 53 days, the average of the 10 by the new route to the Line is less, by 8 days and a little over, than the average for the same month by the old route.

FOR JULY.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Brig Cohansey . . .	1848	July 14	N. York to Rio Grande .	41	27°00′W	44
Bark Mary Ellen . . .	"	20	New York to Rio . .	39	20 05	43
Bark Mindoro	"	6	Boston to Rio	50	23 00	53
Ship Candace	"	12	New York to Canton .	32	28 00	35
Bark Mason Barney . .	"	21	N. York to Buenos Ayres	53	30 39	56
Ship Sartelle	"	23	New York to Mauritius	48	23 30	51
Ship Thos. Perkins . .	1849	19	New York to California	34	21 00	37
Brig Joseph Butler . .	"	2	Nantucket to California	34	31 00	37
Ship Carrington . . .	"	4	New York to Canton .	27	30 20	29
				358		385
			Mear	39.8		42.8

OLD ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
George	1827	July 4	Salem to Calcutta . .	41	18°34′W	43
Thom	1832	20	Sag Harbor, (whaling) .	44	18 00	46
Erie	1836	28	N. York to Buenos Ayres	42	23 40	45
Henry	1803	19	Salem to Batavia . . .	63	19 28	69
Brookline	1839	27	Salem to Manilla . .	50	21 13	54
				240		257
				48.		51.4

July is another difficult month for short passages, because of the breadth of the belt of equatorial calms, and the prevalence of the S. W. monsoons. When you get east of 28° W., these winds are found to prevail

in the summer and fall, from S. S. E. to S. W. almost constantly, and they are liable to be encountered anywhere between 1° N. and 13° N. To the west of 28° they do not blow so regularly, nor do they cover so broad a belt.

FOR AUGUST.

NEW ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Bark Gallego	1848	Aug. 6	Richmond to Rio . . .	42	29°17′W	45
Bark Kathleen . . .	"	24	Richmond to Bahia . .	52	26 45	54
Bark E. Corning . . .	"	19	Baltimore to Rio . . .	35	27 38	37
Bark Brazillero . . .	"	29	Richmond to Rio . . .	34	29 00	36
Bark Kirkland . . .	"	1	Richmond to Rio . . .	42	31 25	45
Brig Independence . .	"	16	New York to Rio . . .	45	32 34	48
Ship Esther Mary. . .	"	3	Boston to Rio	36	33 13	40
Bark Rover	"	4	New York to Rio . . .	37	27 32	39
Ship Malabar	"	4	New York to Callao . .	46	27 40	49
				369		393
			Mean	41		43.7

OLD ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Central America . .	1831	Aug. 3	Baltimore to Pacific . .	35	23°44′W	38
Catharine	1843	12	Baltimore to Montevideo	50	26 36	53
Brutus	1845	7	Boston to Calcutta . .	43	25 00	46
Phœnix	1821	27	Boston to Sumatra . .	40	24 00	44
Cadet	1840	12	Boston to Montevideo .	45	23 00	48
				213		229
			Mean	42.6		45.8

August is another bad and the worst month. Here, also, we have the tracks of nine vessels by the new route. But the mean of them show an average gain of only 1.6 days to the equator, and of 2.1 to clear Cape St. Roque.

The mean longitude of crossing the equator in this month is 29° 30′ by the new route, and 24° 30′ by the old. From the former it requires only 2.4 on the average to clear Cape St. Roque; whereas from the latter 3.2 days are required. In this fact navigators will see that there is no difficulty in crossing as far to the West as recommended by me for this month. Fourteen days is the average of the time required by those 9 vessels to cross the belt of equatorial calms and monsoons; and every vessel, except 3, went further to the eastward than is recommended by the route, and the average of these three in crossing this belt is 14 days.

The "Kathleen" went as far as 24° West, and was 27 days becalmed in crossing this belt. The Independence went, as was recommended, and was becalmed 18 days. Two others, 12 days each. The passage for this month, when the new route shall be properly followed, will be considerably shortened.

FOR SEPTEMBER.

NEW ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Bark W. H. D. C. Wright	1848	Sep 19	Baltimore to Rio . . .	33	29°48′W	36
Brig R. de Zaldo . . .	"	2	Baltimore to Rio . . .	45	29 00	48
Bark Palmetto	"	1	New York to Rio . . .	32	24 30	35
Brig Imperial	"	2	Norfolk to Rio	53	32 54	57
Brig Lion	1849	17	Boston to Rio	37	29 00	40
Ship Oriental	"	11	New York to Canton .	35	30 30	37
				235		253
			Mean	39.1		42.1

OLD ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Washington	1833	Sep 5	New York to Batavia .	43	21°45′W	46
Coromando	1842	23	Boston to Manilla . . .	42	26 00	44
Brewster	1847	14	New York to Concagua	52	26 14	54
St. Paul	1841	11	Salem to Manilla . . .	35	24 00	38
Eliza Ann	1833	15	Boston to Monte Video .	41	27 46	44
Carolina	1843	17	Salem to Rio	45	24 14	47
Potomac	1835	5	Newburyport to India .	42	17 01	46
				300		319
			Mean	42.9		45.6

In September the average passage, as shown by the mean of six voyages by the new route, is 3.8 days less than the average as shown by the mean of 7 per old route.

By the old route the vessels go, on the average, as far as 19° 30′ W., and cross the equator in 23° 50′.

By the new route they are recommended to go as far as 27°, and to cross in 29°; but they have gone, on the average, as far as 26° 30′, and have crossed in 29°; and the average of the time required to cross the belt of equatorial calms is 14 days; so that it does not appear that there is much hope of materially and still further shortening the September passage. The vessels that have tried the new route for this month, appear to have followed it well.

FOR OCTOBER.

NEW ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Bark Lucia Maria . .	1848	Oct.15	Boston to Zanibar . .	34	30°00′W	37
Brig A. Hammond . .	"	11	New York to Rio Grande	44	34 53	47
Brig Eschol	1845	6	Boston to Pernambuco .	34	35 00	37
				112		121
			Mean	37.3		40.3

OLD ROUTE.

Name.	Sailed.		Where bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Lotus	1833	Oct.19	Salem to India . . .	41	25°48′W	45
Great Britain	1845	20	New York to China . .	35	24 23	38
America	1835	25	New Bedford, (whaling)	48	28 00	53
				124		136
			Mean	41.3		45.3

In October the new route shows a practical saving of 3.7 days to the Line, and of 5 days to the latitude of Cape St. Roque. The average crossing place by the old route being in longitude 26° W., and by the new in 33° 20′.

Capt. J. C. Harding of the "Eschol," who crossed in 35° W., writes, "I think favorably of your route as laid down on your Charts of Winds and Currents, to the equator. When bound to the east coast of Brazil, I shall never think of crossing the equator East of Longitude 31°." The intersection of the meridian of 35° with the equator, is too far West to cross willingly.

It took the "A. Hammond" 22 days to cross "Horse Latitudes," on the passage quoted above. Through that part of the ocean, the two routes are generally the same. Therefore liability to calms here, is not peculiar to the new route.

FOR NOVEMBER.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Brig Marshall	1848	Nov. 7	Richmond to Rio Grande	41	27°60′W	44
Bark Cleora	"	21	Richmond to Rio . . .	35	36 18	47
Ship Amity	"	15	Boston to Penang . . .	30	28 00	32
Bark Whiton	"	23	New York to California	35	28 04	37
Ship Kensington . . .	"	27	New York to Batavia .	29	30 00	33
Bark Agnes	"	22	Cape Henry to Rio . .	27	30 00	29
				197		222
			Mean	32.8		37

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Rosanna	1830	Nov. 5	New York to St. Helena	56	23°00′W	58
Cornelia	"	11	Baltimore to B. Ayres .	52	28 40	55
Whiton	1846	28	New York to California	35	25 20	37
Barbara	1844	1	Sag Harbor, (whaling) .	39	23 00	42
Rajah	"	15	Boston to China . . .	45	34 00	47
Roman	"	2	New Bedford to Pacific	35	25 07	37
Sarah Parker	1841	14	Boston to Batavia . .	34	27 09	37
Alasco	1836	3	New York to Batavia .	37	25 00	40
Cuba	1843	19	Boston to Montevideo .	43	22 12	45
Emerald	1823	24	Salem to New Zealand	50	25 56	53
				426		451
				42.6		45.1

The mean of the November passages gives 9.8 days in favor of the new route to the Line. The mean crossing place is in 30° West. The "Cleora" fell to leeward, crossed in 36°, and had twelve days thence to the latitude of Cape St. Roque. But the "Rajah," by the old route, and before the charts were published, crossed in 34° West. She had 45 days to the Line, and only 2 days thence to St. Roque, total 47 days—which is the passage of the "Cleora" after falling to leeward by the new route.

FOR DECEMBER.

NEW ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Brig Andrew M. Jones .	1848	Dec. 1	Richmond to Pernambuco	32	34°32′W	40
Bark R. H. Douglass .	1849	26	Richmond to Rio . . .	38	29 55	42
Ship Virginian . . .	1848	27	New York to China . .	32	25 00	35
Ship Aldebarran . . .	1849	27	Boston to Batavia . .	35	27 00	37
Ship Florence	1848	18	New York to California	40	27 50	44
Schooner Rochester . .	1849	14	New York to California	36	30 00	39
Ship Gosco	1848	12	Boston to India . . .	23	29 20	26
				236		363
				33.7		37.6

OLD ROUTE.

Name.	Sailed.		Where Bound.	Crossed the Line.		Passed Cape St. Roque.
				Dys		Dys
Derby	1825	Dec 13	Salem to Batavia . . .	31	24°31′W	34
Brazil	1841	8	Boston to Sumatra . .	43	21 30	47
Gulliver	1806	22	Boston to Calcutta . .	39	22 10	43
Active	1801	12	Salem to China . . .	41	20 00	44
				154		168
			Mean	38.5		42

In December, the "Andrew M. Jones," when attempting the new route, fell to leeward, crossed the equator in 34° 30′, and yet cleared Cape St. Roque 2 days sooner than vessels by the old route usually do. In this

month, the calms are generally between the equator and 4° N., and it takes a vessel 6 days on the average to cross them.

I have thus taken the trouble to quote a number of passages for every month of the year and by each route, that navigators may the better judge for themselves as to the merits of the two routes.

It will be observed that the length of the passage by both routes, depends very much upon the season: July and the old route giving the greatest average, which is 48 days; the most tedious month by the new route is August, which gives 41 days as the average.

In January there is but little difference between the two routes according to the passages quoted, though according to my investigations, the average passage by the new January route should be less than 30 days; and when it comes to be tried *fairly*, such, I expect, will be the result.

February and March are famous months for quick passages. The new route saves about two weeks on the average for each of these months.

When a vessel finds herself pinched for room, she should never hesitate to pass inside of Fernando do Noronha; and vessels bound around the Cape of Good Hope, will find it to their convenience to cross the equator further to the East than they would if bound to South America or around the "Horn."

I have heard complaints of the new route from but two vessels that have returned me abstracts of their logs, so that I might judge whether their complaints were well grounded. These two vessels were the "Oceanus," in 1848, and the "Clarissa Perkins," in 1849. And it is but just to remark that the complaint, as to the "Perkins," comes from others, and not from her master.

I do not claim for vessels on the new route an exemption either from head winds, baffling airs, or calms. On the contrary, I expressly show that vessels on the new route are liable to all these. Nor do I claim for the new route short passages *invariably*. I only claim that the average of the passages by the new route will be shorter than the average of the passages by the old. I could name a fine sailing frigate, that had a passage to Rio of 100 days by the old route. I could cite the case of other public vessels, that have had like passages, and of merchant vessels that have had 150 days by the old route. But these are the exceptions and not the rule. So doubtless, too, there may be occasionally long passages by the new route.

But to show that it is not the fault of the new route that the "Oceanus" had a passage of 117 days to Rio and the "Clarissa Perkins" 83, I quote abstracts of their logs, by which it will appear that there is every reason to believe that both vessels would have had fair passages to Rio, if they had stuck to the new route.

Letter and Log of Captain W. A. Sullivan, of the Brig "Oceanus."

"I have crossed the equator to the East Indies eight times to Canton—twice to Calcutta; have generally crossed in 28° W., and twice have had to tack to the eastward in 4° 30′ South, in the months of April and June; and this passage I have met with less wind and stronger current than it has been my fortune ever to have met with before.

Abstract Log of the Brig "Oceanus," W. A. Sullivan, from Boston to Rio, 1848.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 A. M.		Winds.
						Air.	Water.	
Mar. 13	No. obse'n.	No obse'n.				40°	42°	N. W. cloudy.
14	" "	" "				45	52	W. "
15	" "	" "				42	68	S. W. and variable.
16	37°12′	64°10′	N. 65° E. 0.9			45	68	S. to W.
17	36 44	60 06	" " 0.9			50	58	Variable from W.
18	35 55	57 53	" " 1.0			62	68	" "
19	34 35	57 10	S. 65°W. 0.3			71	66	S. W.
20	32 55	55 58	None.			66	64	"
21	30 38	53 49	S.45° W. 0.3			66	72	N. W. by W.
22	28 39	52 06	3 Whale.			68	66	W. S. W.
23	26 24	49 26	4 Whale.			74	66	S. W.
24	24 32	47 22	"			74	69	S. W. by W.
25	23 02	47 55	"			74	70	S. W. fresh breeze.
26	22 14	47 25	"			78	70	S. E. " "
27	20 44	48 27	"			69	70	S. E. " "
* 28	20 29	47 24	South 0.4 per h.			74	69	Latter part calm. 12 to 12 A. M. S. E., easterly heavy gale.
29	18 46	47 10	S.S.W.0.4 "			74	69	S. W., westerly brisk.
30	19 03	46 02	None.			74	71	S. E., easterly fresh breeze.
31	16 31	46 42	"			73	71	S. E., " "
April 1	16 39	45 02	"			74	69	S. S. E " " and squalls.
2	16 30	42 34	"			73	69	S. S. E and E. S. E. moderate.
3	14 31	41 18	"			73	69	S. E. and E. S. E. squalls and calms.
4	13 29	38 56	"			72	70	S. S. E. to S. moderate.
5	13 40	37 55	"			71	70	S. S. E. to S. squalls and rain.
6	11 03	36 40	W¼N. 0.4 tenths.			74	69	S. S. W.& N.byE. " "
7	8 42	35 23	" 0.4 "			73	69	N. N. E. pleasant and brisk.
8	6 42	33 20	" 0.5 "			71	69	N. E. very fresh.
9	3 57	31 17	" 0.8 "			75	70	N. E. and E. N. E. strong first part, moderate latter.
10	2 00	31 22	W.N.W. 0.8 "			75	70	E. very fresh.
11	1 39	31 37	7 "			76	72	E. S. E. very fresh.
12	0 44 N.	31 38	West, 5 tenths.			76	72	E. moderate.
13	1 39 S.	31 50	W. 1.0 "			76	72	E. " strong tide rips.
14	2 10	30 59	W.10°N.1.0 "			81	76	N. N. E. light winds.
15	3 05	52 50	W. 1.5 "			84	81	E. S. E. " "
16	3 57	35 10	W. by N.2.5 "			84	78	E. S. E. " "
17	3 40	34 12	" 2.5 "			84	78	E. S. E. " "
* 18	2 00	37 15	" 2.5 "			81	76	N. E. and E. squalls and rain.
19	1 56 S.	39 40	" 1.8 "			81	70	N. E. and E. " "
20	1 20	39 12	" 1.5 "			76	65	Variable from N.
21	0 44 S.	40 20	W.N.W. 1.9 "			76	70	Variable and light airs.
22	0 10 S.	41 01	" 1.9 "			76	70	Moderate squalls from E.
23	0 15 S.	40 59	" 1.02 "			76	70	" " "
24	0 20 S.	41 20	" 2.00 "			76	70	Calm.
25	0 15 S.	42 00	" 1.5 "			76	72	Light airs from E.
26	No obse'n	No obse'n				76	72	Light airs from E. and cloudy.

* This is the strange proceeding. With the wind from E. S. E., to N. E., and wanting to go South, he runs off to the northward and westward.—M.

Abstract Log of the Brig " Oceanus."—Continued.

Date.	Latitude at noon.	Longitude at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	THER. 9 a. m. Air.	THER. 9 a. m. Water.	Winds.
			In 2 days.			°	°	
April 27	1°00′ N.	43°00′	" 50 miles.			76	70	During this week I had the wind from E. by N. and E. by S., light airs, and a strong west set, steering N.; wind enough to move the brig 2 and 3 knots.
28	1 40	43 50	W. N. W. 1.2			76	70	
29	2 30	45 12	" 1.5			76	72	
30	3 28	46 45	W. by N. 1.2			78	74	
May 1	5 50	47 30	W. N. W. 1.3			68	70	
2	4 15	47 50	" 1.3			68	70	
3	5 21	48 20	" 1.5			68	70	
4	6 15	49 11	" 1.5			68	70	E.N.E. good breeze, moderate.
5	7 12	50 10	" 1.5			68	70	E. good breeze, moderate.
6	9 40	50 20	" 2.2			64	68	S. S. E. " "
7	10 56	50 27	" 1.9			74	78	Variable and light airs from eastward.
8	11 31	52 00	" 1.0			80	77	Variable and light airs from eastward.
9	10 12	52 48	" 1.0			80	80	Variable and light airs from eastward.
10	9 13	52 11	" 1.5			87	88	E. N. E. squalls and rain.
11	8 43	51 39	" 1.0			88	87	Light airs and calms from E.
12	9 49	52 00	" 1.0			80	80	" " "
13	11 27	52 12	1.0			88	78	E. N. E. moderate breeze.
14	11 19	51 42	1.2			78	80	E. N. E. light airs and calms.
15	10 47	51 11	1.0			78	80	E., & E. by N., squalls and rain.
16	10 01	50 21	1.5			78	80	Variable from E. and squalls.
17	10 00	50 10	N. W. 0.4			80	80	Light airs and pleasant. From 12 to 1 no current,—set in at 3 in a tide rip.
18	9 32	49 03	W. N. W. 1.3			80	80	E. current stronger in afternoon than morning.
19	9 55	49 05	W. 1.0			79	81	E. heavy squalls and rain.
20	8 55	48 08	" 0.6			80	81	E. " "
21	7 59	46 05	" 1.7			80	79	E. N. E light squalls and rain.
22	6 59	46 05	" 1.0			75	80	N. E. rain squalls; no wind.
23	5 29	45 23	" 0.5			80	80	E. and E. S. E. squalls, light air and rain.
24	4 17	43 50	" 0.5			80	81	N. E. by E. moderate squalls and rain.
25	4 03	43 40	" 0.5			79	81	E.N.E. light squalls and calms.
26	3 16	43 14	" 0.5			79	82	Var. from N. E. to S.S.E, light squalls of rain.
27	None.	None.	—			80	81	Calm, heavy rain.
28	4 26	Lun. 42 55 Cro: 42 47	2 days 0.4 N. N.W.			80	82	Light airs and calms.
29	5 24	42 21	0.7 W.N.W.			80	81	Squalls, light airs N. N. E.
30	5 52	41 58	0.7 "			80	79	Light baffling airs and squalls from S. E.
31	6 18	41 32	0.9 W. S.W.			80	81	Fresh squalls and rain variable from E.
June 1	6 29	40 32	1.2 "			80	81	" "
2	5 55	40 30	1.2 "			80	82	" "
3	5 45	40 09	0.5 S. S. W.			80	81	Light airs and calms from E.

Abstract Log of the Brig "Oceanus."—Continued.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation *observed.*	Bar.	THER. 9 a. m. Air.	THER. 9 a. m. Water.	Winds.
June 4	5°26′ N.	39°45′	0.7 W.N.W.			80°	79°	Moderate breezes from E.
5	5 32	29 15	1.3 N.N.W.			80	81	" "
6	4 40	38 40	0.4 W.			79	82	Variable from E. S. E. to S. S. E., squalls and rain.
7	4 40	37 50	0.4 N.87°W			79	82	E. squalls and rain.
8	4 11	37 44	0.5 W.N.W.			79	81	Moderate calms and rain; heavy tide trips.
9	4 16	36 01	0.5 N.W.by W.			80	81	S.E.& S.by W.heavy tide rips.
10	5 24	35 32	1.0 N.25°W.			79	80	Rain and cloudy; good breeze.
	No obs'n.	No obs'n.						
11	D.R.5°42′ N.	D. R. 34°42′	—			78	80	S.S. E.,good breeze & cloudy.
12	D.R.5 15	D. R. 33 55	—	*		76	78	S. S. W., " "
13	D.R.4 17	D. R. 33 05	—			79	78	S. W., " "
	D.R.3 03	ob.c.32 14	In 4 days.					
14	ob.c.4 41	D. R. 32 14	N. 42 E. 2°42′			79	78	S. W., " "
15	4 01	28 51	N. 64 E. 1 00			78	80	S. S. E., rain.
16	2 57	29 48	No current.			79	80	S. S. E., moderate & pleasant.
17	1 50 N.	30 53	0.8 per h. W.			79	79	" " "
18	0 22 N.	32 57	1.8 " "			78	80	S.E.by S., squalls & moderate.
19	0 19 N.	32 15	3.8 " "			78	79	" " "
20	1 01 N.	31 52	0.9 " "			78	81	S.E. " "
21	0 13 S.	31 52	0.8 " "			78	80	S.E by E.&E. S. E. moderate.
22	2 13 S.	32 01	0.8 " "			78	79	S. E., stiff breeze.
23	2 00	31 34	1.0 " "			78	79	" "
24	4 07	32 41	1.0 " "			79	80	E. S. E., "
25	5 24	33 35	1.0 " W.N.W.			80	79	S.E.& E.S.E.,heavy squalls of 4 h. duration, double reefed.
26	7 01	34 19	N. 22°W. 1.2			79	79	E., fresh breeze and pleasant.
27	7 09	33 55	W.N.W. 0.8			79	79	S. S. E., moderate "
28	8 07	34 49	N.N.W. 0.9			80	78	S. E., moderate; at 7 A. M. Olinda S. W. by S. 7 miles; at noon Pernambuco abeam and St. Augustine S. W. by S. ½ S.
29	9 30	34 56	" 0.2			79	77	E. S. E. & N. N. E., moderate.
30	11 35	35 05	None.			79	77	E. N. E., moderate.
July 1	13 43	35 15	"			78	77	" "
2	15 29	35 32	"			78	77	Brisk from E. N. E.
3	16 44	26 05	0.2 S.			79	76	W. and N. N. E., moderate.
4	18 12	36 45	No current.			79	78	Variable from W. to S. S. E.
5	19 03	37 17	"			78	78	W.N.W. & N.N.E., moderate.
6	20 15	38 30	"			78	77	N. N. E.& N., strong breeze.
7	22 20	39 52	"			77	78	N., very fresh; saw 5 sperm whales.
8	23 15	41 52	20 miles in 24 h.	Made Cape Frio at 12 Noon, N. W. by W., 12 miles.				

* NOTE.—These four days, after taking five observations, convinced me of a set to East northerly of great force. Hardly believed by myself, and probably will be doubted by you. Every token of a strong current—and after throwing my log with a heavy weight, I found such was the case. I have always known such exist northward between 7 and 10, east of 30° of West Longitude. It is the first easterly current I experienced. As I have before mentioned, I have never experienced so much and steady current save in China seas, Straits of Bally, and about the Islands. The ship Heber, spoken thirty-six days from New York, satisfied me, as the Captain stated the same easterly current had been felt by him. I took several lunar observations, but finding them agree so nearly to chronometer, I have not, but in one instance, taken note of them.

Captain Sullivan to Lieutenant Maury.

"You will see by this abstract from my experience that an ordinary vessel in point of sailing stands but little chance to cross the line in over 30° W., in the months of April, May, and first part of June. In any other months I should think differently.

I have had light airs, and could not have had better opportunity to judge of currents, to which I have devoted my attention.

If this prove any benefit to you I shall be partially repaid for the long and tedious voyage.

With respect, I remain your most obedient servant."

It will be observed that Captain Sullivan followed the new route faithfully to the Line, which he crossed after a passage of 30 days, in Long. 31° 42′, with the wind at East. That from the 15th to the 16th of April, with the wind at E. S. E., and wishing to steer *South*, he made a course and distance good of 150 miles W. N. W.! and that from the 17th to the 20th, with the wind from the *northward* and *eastward*, and as fair as he could have it to blow for his course to Rio, he ran off away to the northward and westward instead of to the southward and eastward, until he brought up in the mouth of the Amazon! Surely this is neither the fault of the charts nor the route. The brig then beat about to the north of the line, and at the end of 78 days returned to it again; and on the 21st of June, succeeded in recrossing it in 31° 52′; that is within ten miles of where she had crossed it in April the first time.

With the winds now at S. E.—less favorable than they were the first time—she had no difficulty in clearing St. Roque in 4 days from the line, and in getting to Rio in 13 days afterward. This "mysterious hanging of the brig about the line" is certainly in no wise connected with the new route.

In justice to Captain Goodrich of the "Clarissa Perkins," it should be observed that he does not charge his passage of 83 days to Rio to the new route. On the contrary, he distinctly shows that the fault was not with the charts nor with the route, but with his passengers; and with a candor that is in the highest degree commendable, he himself admits his mistake in steering to the westward after crossing the parallel of 32° N., see his abstract, page 376, his winds and courses from February 16th to March 8th, and the remarks in brackets, ( ), which are my own.

Captain G.'s log and remarks are of much value, and I take this occasion to express my thanks to him for the information afforded by them.

Letter and Log of Capt. Goodrich, of the "Clarissa Perkins," to Lieut. Maury.

REALIJO, *March* 22, 1850.

"A few days since I sent you by private conveyance my journal of the ship "Clarissa Perkins," under my command, from New York to San Francisco, from thence to this port. I preferred to send the journal, that you might see more fully than I could express in abstract form.

You will perceive I fell to the leeward of Cape St. Roque, yet I would again pursue your route, for I still have confidence in the same. There were at the same time several other vessels much farther West than myself, yet they made a fair passage into Rio de Janeiro. And I there heard of the shortest passage being made by a vessel that made land several degrees West of that Cape.

It was my misfortune to have 140 passengers on board, my vessel only 240 tons, and to them I do in a great measure attribute my not getting round sooner. They interferred much with my duty: protested or remonstrated against my coasting along the shore. And often to prevent some dissatisfaction I stood seaward out of sight of land, and consequently experienced a strong current.

Of my passage from San Francisco to this port I have nothing to say, as you have the journal.

The diversity of opinion is such that no one pretends to give information or instruction for navigating this coast. The prevailing opinion, however, is to coast along in sight of land at all seasons, if bound southerly. And bound up the coast about as may vessels follow the coast along as there are of those that stand well off the coast. It astonishes me, and also many others of my profession, to see how little is known of the winds and currents in the North Pacific ocean.

In contrast with my long passage, I forward herewith the extracts of some other vessels whose journals or log books have fallen under my notice. I shall leave this port in about 7 days on my return passage to San Francisco, and I there shall be most happy to hear from you, acknowledging the receipt of this and also the journal. Should you write, please direct "Care of E. E. Dunbar, Esq., San Francisco, California."

ABSTRACT LOG OF THE SHIP "CLARISSA PERKINS," JAMES W. GOODRICH, COMMANDER, BOUND FROM NEW YORK TO SAN FRANCISCO.

Date.	D. R. Latitude at noon.	Observed Latitude at noon.	Longitude at noon. D. R.	Longitude at noon. Observed.	Ther. 9 A.M. Air.	Ther. 9 A.M. Water	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
1849 Feb. 7	39°44′ N.	—	71°36′W.	—	—	—	N.E. to E.S.E.	W.N.W. to S.W.	WSW. to WNW.	Sailed.
8	38 21	—	67 50	—	—	—	W.N.W.	N.W. by W.	N.W. by W.	Strong gales, and squally.
9	37 40	—	64 27	—	56	79	N.W. to W.	W.S.W.	W.S.W. to N.W.	" " "
10	35 40	36°40′	61 20	63°01′W.	50	61	N.W. by W.	N W.	N.W.	" " "
11	35 09	35 07	58 58	—	59	66	N.W. to W.N.W.	W.S.W.	S.W. to S.S.E.	Strong gales, and squally. Latter part moderate and calm.
12	35 00	35 01	56 36	—	61	65	S. by W. to S.	S.S.W	S.W.	First part moderate—latter part gales. Ship under close-reefed topsails.
13	34 52	—	53 39	—	61	—	S.S.W. to S.	S.	S.W. to W.	Strong gales, and squally.
14	32 54	34 25	52 16	55 22	61	61	W.	N.W.	N.W.	Moderate breezes.
15	32 43	32 35	51 04	54 32	67	—	N.W.	N.W. to N.by W.	N.by W.&baffling	Pleasant.
16	32 45	—	49 37	—	69	69	S.E. var. S.W.	S. by E.	S. by E.	Light winds. (Stood W.N.W. 5 hours, 19 miles, with wind S. W.)
17	32 32	—	47 03	—	73	66	S.	S.	S.	Pleasant.
18	32 16	—	44 27	—	72	68	S.S.E.	S.S.E. to S.by W.	S. by W.	Unpleasant and squally.
19	31 14	32 39	43 29	—	70	66	S.by W. to S.S.E.	S.E. by S.	E.S.E. to S.S.E.	Pleasant. (Stood S W. 4h., 20 miles, wind SSE)
20	31 27	31 27	44 48	47 58	71	68	S.S.E.	S. to S. by W.	S. by W.	Pleasant. (Course all day from W. by S. to S. W. ½ S., 104 miles.)
21	30 39	30 46	48 06	48 36	72	68	"	S.W. & variable	N.W. & variable	Light winds. (Stood S.W. 9 hours, 30 miles, wind S. S. E.)
22	28 47	28 55	47 46	47 02	72	68	N.	N.E.	E. to E. by S.	Pleasant. (Think there is a mistake in longitude by chronometer.)
23	27 02	27 25	47 16	47 04	69	71	E.	E.	S.E. to S. by W.	Moderate breezes.
24	26 31	26 52	46 04	45 38	71	72	S.W.	S.W. to S.E.	SSW.NWSbyW.	Light and variable.
25	24 56	25 26	43 49	43 38	71	72	S.S.W.	S.W	S.W. by S.	Fresh and squally.
26	24 02	24 21	41 47	41 28	72	73	S.W. to S.S.W.	S.S.W.	SW by W to SSW.	" "
27	23 38	23 51	40 35	39 41	74	72	S.S.W. to S.by W.	S.by W to SW by S.	S.W. by W. to S.	Moderate breezes. (Stood W.S.W. 3 hours, 4 miles, wind S.)
28	22 46	23 21	40 08	39 58	73	74	S. by E	S.	S.W. & S.	Light breezes.
Mar. 1	22 37	22 53	39 45	38 58	76	72	S.	S.	S.	Pleasant. (Stood W.S.W. 8 hours, 40 miles, wind S.—and W. by S. ½ S. 4 hours, 20 miles, wind S.)
2	22 19	22 31	40 13	—	74	73	S.	S.	S.	Pleasant. (W. S. W. 12 hours, 49 miles—W. S. W. 4 hours, 13 miles, 62 miles.)
3	21 33	21 47	41 11	40 24	76	75	S.	S.E. by S.	S.E. by S. & S.	Pleasant. (Stands to southward and westward all day, 83 miles by log.)
4	20 07	20 20	41 30	40 26	78	76	S.E.	S.E.	S.E. by E.	Pleasant.
5	18 45	18 52	41 30	40 31	76	75	S.E. by E.	E.S.E.	E. to S.E.	"
6	18 27	18 50	40 50	40 04	76	74	S.	S.	S. & S. by E.	Moderate. (Stood WSW 8h., 32 miles, wind S)
7	17 49	17 39	42 16	42 15	78	—	S. by E.	S. by E.	S. by W. & S.	Moderate. (Stood to southward and westward 23 hours, 103 miles.)

8	16 55	17 02	43 12	43 22	77	76	S.	S. by W.	Calm.	Light. (Stood to southward and westward 17 h., 63 miles.) "This and the preceding day is another great error—my not standing to the eastward on the starboard tack."
9	16 35	16 40	43 40	43 32	85	78	Calm.	S.	S.S.E.	Light airs. (Stood to southward and westward all day—40 miles by log.)
10	15 33	15 42	44 21	44 00	82	78	S.S.E.	S.S.E., S.E. ½ E.	"	Light breezes. (Stood to southward and westward all day—81 miles by the log.)
11	13 51	13 46	44 51	44 41	83	78	S.E.	S.E.	S.E., S.E. by E.	Pleasant.
12	11 56	11 51	44 44	44 16	81	79	S.E. by E.	E.S.E.	E. by S.	Moderate breezes.
13	10 05	9 50	43 29	43 20	81	81	E.	E., E.N.E.	E.N.E. by E.	Mod. breezes and squally—took N.E. trades.
14	7 02	7 35	41 54	41 19	82	81	E.N.E.	E.N.E.	E.N.E., NE. by E.	Fresh breezes.
15	5 53	5 59	40 49	40 28	81	80	E. by N.	E. by N.	E., E. by S.	Moderate breezes.
16	4 29	4 09	39 36	39 42	81	80	N.E. by E.	E. by N., E.	E.N.E. to E.S.E.	Moderate breezes and squally.
17	2 39	—	38 27	—	79	80	E.N.E.	E.N.E. to E.S.E.	E.S.E. to E. by N	Fresh breezes and squally.
18	1 07	—	36 50	—	81	81	N.E. by E. E. by N.	E. by N., NE. by E.	E.N.E.	Good breezes.
19	0 35 S.	1 02 S.	35 20	36 26	86	84	E. by N.	E.N.E.	E. by N.	Good breezes. "At ½ past 7 P. M. the ship is on the equator, in longitude 36° 42′ W. This is 10° W. of the usual route of vessels, crossing the equator, bound S., and is 7° W. of my most western long. in any previous voyage. This month proved unusually favorable for pursuing Lieut. Maury's route to the equator." "In no instance have I carried the N.E. winds to the equator." "An inspection of my several voyages shows this to be shorter than the average I have made; shortest 31½ days, longest 54 days—but chiefly forty days from New York."
20	2 46	2 08	35 19	36 32	84	82	S.E. by E., E.S.E.	E.S.E.	S.E. by E.	Moderate breezes, with showers.
21	3 42	3 24	35 17	37 10	88	84	S.E. by E.	E. by S.	"	Light winds. Current W. N. W.—about 45 miles by log.
22	3 44	3 10	35 02	37 27	85	84	S.S.E. to E.	E.	E.S.E.	Light winds. Stood N. N. E. 8h., 32 miles, wind E.N.E. ½ N. 4h., 16 miles, wind E.S.E.
23	3 09	2 45	34 22	37 26	85	84	E.S.E.	E.S.E., E. by S.	E. by S., E.S.E.	Light winds. Strong westerly current.
24	1 44	2 12	33 57	37 55	84	83	E. by S. to E. by N.	E. by N.	" "	Light winds. Strong westerly current. W. 60 miles—N. 23 miles.
25	2 39	2 38	33 15	37 46	84	84	E.S.E. to E. by N.	E. by N. to E. by S.	E. by S.	Light winds. Current W. 27 miles. "During the night my suspicions are awakened that my compasses are greatly erring. In the morning I make comparisons with the azimuth compass—my suspicions are true. The compasses greatly err. An examination takes place, and there is discovered 3 pointed bolts of ⅜ inch size and about 6 inches long—one was on the front part of compass box, and two directly under the box."

ABSTRACT LOG OF THE SHIP "CLARISSA PERKINS."—CONTINUED.

Date.	D. R. Latitude at noon.	Observed Latitude at noon.	Longitude at noon. D. R.	Longitude at noon. Observed.	Ther. 9 A. M. Air.	Ther. 9 A. M. Water	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
Mar. 26	4°09′ S.	—	32°31′ W.	—	8°	83°	E.S.E.	E.N.E.	E. by S. to E.S.E.	Light breezes.
27	4 10	4°06′ S.	31 34	36°48′ W.	80	83	N.E. by E.	N.N.E., N.W. N.W. by W.	S. baffling, N. W.	Light breezes. Half past 1 P. M. saw land S. W. (Stood N. N. W. 2 hours—5 miles. Wind S.)
28	4 01	3 54	30 12	35 39	80	83	N.W.	N.N.W.	E by S to SEbyE.	First and middle parts fresh breezes—latter part light.
29	5 06	4 44	29 25	35 05	79	83	E S.E to S.E by S.	ESE to S.E. by E.	S. by E. to S.	Good breezes.
30	4 57	4 32	28 59	34 57	83	84	SEbyE to E.S.E.	E.S.E., E.	E. by S., E.S.E.	Light. Would wish to go in shore, and avail myself of the land and sea breezes, but dare not do so, for fear of some of the passengers.
31	5 15	5 16	28 42	34 57	79	83	S.E. by E. to E.	NEbyE to E.by S.	E. by S., S.E. by E., E.	Light and squally. "Too far off shore to profit by land and sea breezes." Land in sight.
April 1	4 56	4 33	28 01	35 09	80	83	E.	E.S.E. to E.by S.	E. by S. to S.E.	Light breezes. Cur. N. 19 miles, W. 53 miles.
2	4 49	4 34	27 29	34 48	83	83	S.E	ESE to S.E.by E.	SE by E to E.S.E	" "
3	4 22	4 05	26 43	34 08	84	83	ES.E. to S.E. by S.	S E. by S.	S.E. to E.	" "
4	5 06	4 29	25 15	34 41	85	83	S.E. by S	S.E. by S.	S.E. by S., S.E.	" "
5	5 36	5 02	25 17	35 05	—	—	S.E. to S S.E.	SEbyS to SEbyE	S.E., S.S.E.	Mod. breezes. Land about St. Roque in sight.
6	5 17	4 33	24 04	34 25	83	83	S.S.E.	S.S.E.	S.E. by S.	Moderate breezes. Would like to coast along in shore, but dare not.
7	5 10	—	24 00	—	81	82	S.S.E. variable.	S.E. variable.	S.E. variable.	Light breezes. Strong current to N'd. and W'd. yesterday and to-day.
8	5 36	4 56	23 40	35 12	79	84½	S.S.W. to N.N.E.	Calm	SE by S. variable.	Light breezes. 2 days current. N. 40 miles, W. 75 miles.
9	5 25	5 06	23 17	35 09	84	83	S.E., S.E. by S.	SSE to S.E. by S.	S.S.E., S.E. by S.	Light breezes. Estimate current N.W. ¼ W. 31 miles per day for 21 days. Stood off shore, although the ship was running along parallel with the land, Cape St. Roque in sight.
10	5 19	5 00	34 33	35 07	83	83	S.E.	S.E. by E.	S.E.	Light winds. Strong current—have advanced only when in shore.
11	5 24	4 54	33 44	34 41	84	83	S.S.E.	S.S.E.	S E. by S, S.E	Light winds. Strong current.
12	5 24	5 00	33 16	34 58	83	83	SEbyS to SEbyE.	S.E. by E	S.E. by S. to S.E.	Light winds. Land in sight. Strong current W. 44 miles.
13	5 56	5 36	32 46	34 54	84	83	S.E. by S.	S.E.	S.E.	Light winds. "The further off shore, stronger current." S. W. by W. 50 miles.
14	6 02	5 17	32 30	35 05	83	84	E.S.E.	SEbyE to E.S.E.	E.S.E.	Light winds. "A ship passes in shore of us."
15	6 04	5 53	32 21	35 07	83	84	SEbyE to E.S.E.	E.S.E.	E.S.E.	Light winds. Stand in shore and find not so much current.
16	6 32	6 16	31 56	35 05	84	84	E.S.E. to S.E.	S.E. to E.S E.	E.S.E., E.	Light winds. Land distant 7 miles at noon.
17	6 46	6 35	31 40	34 59	87	84	E.S.E.	E.S.E.	E.S.E.	Light winds.

Apr. 18	7 17	6 52	31 42	34 56	89	84	E.S.E.	E., to E.S.E.	E.S.E.	Light winds. In 9 days set 201 miles N. and 202 miles W.
19	9 00	8 32	33 51	34 12	84	84	E. by S., E.N.E.	N.E. by N.	N.E. by N.	Moderate breezes and pleasant. "As I am now clear of Brazils, I make this solemn protest against certain persons whose mutinous threats have so far intimidated me as to cause my often tacking, and otherwise manœvering my vessel that this passage has been prolonged." "In fact, where I have gained along this coast, it has been through *stealth;* for, to gratify some wishes and desires, I have, at close of day, gone about, heading off shore, and actually kept standing on for 20 hours *ere* I found occasion to tack. This I mention to show how harrassed has been my situation, and the constant fear I have been under, through the threats and declarations of open piracy and mutiny here on board."
20	11 11	—	33 04	—	85	83	N.E., N.N.E.	N.N.E.	N.N.E.	Good breezes and pleasant.
21	12 38	12 39	33 01	32 47	85	84	N.E. to N.W.	W., WSW., N.E.	N.E., N.	Moderate and pleasant.
22	13 30	—	33 04	—	78	83	NNE. to N.N.W.	Variable.	S. by E. to S. by W.	Light breezes and variable.
23	14 27	14 23	34 49	35 05	83	82	S.S.E.	S.S.E.	S.S.E.	Fresh and cloudy.
24	15 36	15 38	36 26	37 10	81	80	S. by E.	S. by E.	"	Fresh and squally.
25	16 51	16 49	37 50	38 27	79	81	"	"	S. by E.	Moderate breezes.
26	18 11	17 54	37 46	38 38	81	79	S.	S.E. by E.	S.E. by E.	Light and pleasant.
27	19 29	19 46	37 54	38 48	83	77	Baff. N.E. by E.	N.E.	N.N.E.	" "
28	21 36	21 18	39 16	39 04	80	79	N.E.	N. to E.N.E.	N.N.W., N.W.	Moderate and pleasant.
29	21 51	22 22	40 21	40 08	81	79	N.W. by W.	Westward.	N.W.	" "
30	—	22 48	—	—	82	78	N.W.	N.W. by N.	Baffling.	Moderate and pleasant. Standing in towards Cape Frio.
May 1	—	—	—	—	77	78	"	Baffling.	Baffling.	Moderate and pleasant. Anchored in harbor of Rio de Janeiro.

As to this candid statement and fair exhibit of the Log, no comments are required to exempt Captain Goodrich from all blame in the matter; nor is any remark necessary to show that the length of the passage is in any way ascribable to the new route. Routes had nothing to do with the conduct of passengers, who interfered with the navigation of the ship in the most unjustifiable manner.

I may here remark, before dismissing the subject of complaints against the Wind and Current Charts, that I have heard that complaints have been made on the part of other vessels also. But in every instance, except the two quoted, the masters of the complaining vessels have taken care to conceal their journals. They have not, as they were under the pledge of word of honor bound to do, furnished me with an Abstract Log of their voyage. With the evidence before one, that that affords, the impartial navigator would be at no loss to decide whether the fault of the passage be owing to the new route or to bad navigation.

Those navigators were supplied with the charts on condition that they would keep and furnish me regularly with Abstracts of their Logs. They signed a receipt for the charts containing such a condition. And whether they make long or short passages, I am equally entitled to the fulfilment of their engagement. The Abstract of a long voyage is more valuable than that of a short one, because the former has more observations, and may lead to the discovery of faults in the charts.

To the honor of American ship-masters be it said, that those who fail to keep Abstracts according to promise are very few. The great majority of them are co-operating with me in this great work, with a zeal, ability, and effect the most creditable. And to such I cannot too often, or too sincerely express my grateful acknowledgments. I am proud of their assistance. Their aid encourages me.

Returning to the study of the monthly passages by the two routes, and to the examination of the charts. it will be perceived that the most pertinent question for the navigator to make with regard to the route hence to the southern hemisphere, is not "where shall I cross the equator?" but "where shall I lose the N. E., and where get the S. E. trades?"

Hence, it will be observed that by following these Sailing Directions vessels will occasionally be compelled to go as far East as longitude 25° W.; but this is North of the equator, and in those regions and months where the N. E. trades usually fail.

I have given, with all the mistakes, the passages of 89 vessels that have attempted the new route, and of 73, also taken at random, that have gone by the old route. As the result shows, that the routes which I have proposed, and which were followed by these 89 vessels—many of them doubtingly—has reduced the average sailing distance from the ports of the United States to the equator, as much as two weeks for some months; 10 days as the average for the winter and spring, and one week as the average the year round.

The average passage to the Line the year round is, by the old route, 41 days, by the new, 34.* Thus exhibiting a saving of about 17 per cent. of the usual time under canvass hence to the equator; which saving

*This was written and published three years ago. Since that time navigators have learned to follow the new route better. Twenty days is now not an uncommon passage from New York to the line, and some of the new ships talk of making it in 16. One, the "Flying Fish," has made it in 18,—see her Abstract Log.

is among the first fruits of the Wind and Current Charts, and of that system of investigation, with regard to the winds and currents of the ocean, that the patriotism, intelligence, and public spirit of American ship-owners and masters have enabled me to pursue with such signal advantage to the commerce of the country.

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Abstract Log of the "Flying Fish," E. E. Nichels, Commander, bound from Boston to San Francisco, 1851.

Date.	Latitude, at noon.	Longitude, at noon.	Course.	Distance.	Bar.	Ther. 9 A. M. Air.	Water. Surface.	Water. Depth.	Winds.	Remarks.
Nov. 7	40°37′ N.	67°30′ W.	S. 56° E.	185					N. to N. N. E. brisk.	At 8 P. M., Cape Cod, W. by S. 10 miles. Cloudy weather, all set.
8	37 55	62 10	57	302					N. N. E. fresh.	Cloudy—in sky sails: passed a ship under double reefs.
9	35 48	56 46	63	304					N. to N. E.	Cloudy weather—light sails—decks flooded with water over lee rail.
10	32 28	53 50	67	252					N. E. strong.	Fair weather—in top gallant sails—sudden change to warm weather—slacked all rigging.
11	29 44	48 13	60	336					N. E. to N.	Clear weather, in top gallant sails—passed a ship under close reefs.
12	27 27	44 25	57	243					N. N. W. fresh.	Fair weather—wind moderating gradually: set light sails.
13	25 16	42 42	34	162					N. W. by N. brisk.	Very pleasant weather—all sail; one week out—average, 255 miles per day.
14	23 36	39 25	61	206					N. W.	Pleasant weather—all sail.
15	21 27	37 29	40	169					N. W. to S. W.	" " "
16	19 00	34 36	47	221					S. W.	Changeable " "
17	17 24	33 38	30	111					S. W. to S. S. E.	" " "
18	16 21	34 48	S. 46 W.	92					S. to S. E. light.	Weather unsettled—rainy—all sail.
19	13 14	35 10	7	188					S. E. by E. moderate.	Pleasant, trade-like weather.
20	9 50	34 00	S. 17 E.	213					S. E. to E. brisk.	Pleasant weather—all sail—2 weeks out—average 213 miles p. day.
21	6 34	31 55	32	232					E. by S. to E. by N.	Changeable weather, some rain—all sail.
22	5 02	30 45	17	116					E. by S., S. to S. W. moderate.	" " tack twice "
23	4 58	30 07	85	40					Southerly—light or calm.	Very pleasant—all sail.
24	2 31	30 48	S. 15 W.	154					S. E. brisk.	Changeable weather—all sail.
25	0 24 S.	32 04	S. 24 W.	190					S. E.	Pleasant—all sail—19 days to line—average 196 miles; saw 2 American ships bound home.
26	2 40 "	32 30	14	140					Moderate.	Weather changeable and showery—all sail.
27	5 04	32 50	4	144					E. S. E.	Pleasant weather—all sail—passed Fernando Norhona Islands, 190 average.
28	7 14	32 44	S. 3 E.	131					S. E. Baffling, moderate.	Unsettled weather—all sail—saw ship bound to northward.
29	10 06	33 48	S. 20 W.	184					E. S. E. moderate.	Fair weather—a bark in co.—all sail.
30	12 38	34 28	15 "	158					E. S. E. light.	Weather pleasant. "

Notwithstanding the tables and explanations given in the body of this work, concerning the route to Rio, I find navigators who attempt to follow the charts, frequently setting up their own individual experience against that which the charts give of the multitude; and generally as often as they do this, I find them going astray, prolonging their passage, or committing blunders of some sort for which there is no necessity, and for which owners and the commerce of the country are made to suffer.

The tracks with the arrows (Plates VI and VII) are the tracks which I have recommended, and the dotted tracks are some of the tracks which have actually been performed.

Now, suppose we had the tracks of a hundred ships, hence to Rio, all made in the month of January of different years; that in every instance and with every change of wind, each one of the ships making these tracks had have been managed without a mistake—that they had in every instance steered the best course it was possible to steer—that when necessary to go about, each one had gone about exactly at the right moment; and, that whenever the wind came out ahead, they had, all of them, without exception, invariably gone off on the right tack; and that the tracks of these hundred vessels—no two of them having, let it be supposed, sailed in company—was projected on a chart before us. What should we have? We should probably have a hundred separate tracks, for it can scarcely be supposed that any two of them would coincide all the way. And the navigator with that chart before him, would have displayed before him, as clear as he has the Sun at mid-day in a cloudless sky, the best route to Rio in the month of January.

Now, suppose that with these 100 tracks before us, we should wish to draw a line or describe a route, which should represent the mean average track of the entire 100 ships. We should then point to this track and say, this is the route pursued by these 100 vessels, and this, therefore, is the route for all vessels to take in the month of January; and when we should come to look at the January route thus recommended, we should find, probably, that not one of these 100 vessels had actually sailed, even for one mile, or for one foot, upon it; that they had crossed this mean path, now in this place, now in that; at one time from this side, and again from that. Under such circumstances, no right-minded mariner would hesitate for a moment about taking this route. But he would not attempt to describe, with the keel of his ship, the line that he had drawn on the chart merely to designate the parts of the ocean through which she was to pass.

Now, this has been actually done with regard to the routes here recommended: they are the mean or average tracks, in some parts of the way, of 700 such vessels in a month; in other parts, only for 20, or whatever be the number of observations that could be procured.

It is true, that in the case of the charts, I have not actually had 100 such unerring vessels to give me the mean or best average route for each month, but I have had what perhaps was better. I have had the direction of the wind in each district of the ocean given for 100 times and upwards for each month in different years; and when the navigator is told the direction whence the wind comes, he can tell as well what course he could have steered as though he had himself been there, and actually steered it.

I have, therefore, summed up all the winds and calms for each month in every district on the Pilot Chart, and calculated the chances of head winds, and of fair winds, for every point of the compass, through every

such district. With these, I then proceeded to determine, by mathematical discussion, the mean or average route, which, taking both calms, head winds, and increase of distance into account, should give on the average the shortest passage, in time, to the equator.

Of course, then, when a vessel comes to try the new route thus computed, and to project on the chart the track she actually makes through the water from day to day, it is not to be expected, that the track so performed, will when laid down, exactly overlay the one already projected on the chart as her guide. There will be a general conformity between the two, but nothing like the actual coinciding of two lines.

These remarks are called forth by the fact, that some navigators appear to think that there is some sort of virtue in the black mark on the chart, which represents any one of these routes—As the April route for instance: if driven from the April route by head winds, one of these navigators, had he been in the "Memnon" at *a*, (Plate XI,) would have stood north to get her keel on the black mark for April; and again at *b*, he would have stood to the southward and westward to get upon the April track again.

Now, the "Memnon" at *a*, or at *b*, was in just as good a position as she would have been had she been "right upon the track." Her very clever master, therefore, did right; he conformed to the sailing directions, and was pursuing the route recommended, as closely and as well as though his track had fallen all the way from *b* down to the equator, upon the line with the arrows which is projected on the chart to represent the April route.

The tracks of the vessels projected on Plates XI and XII, have not been selected on account of their short passages; many other vessels have made passages shorter than these. I have taken them only for the purpose of illustration and demonstration.

In the conformity between the April route of the chart, and the actual track of the "Memnon" in crossing the calms of Cancer, the charts show a sharp elbow thence to the equator. The "Memnon," without intending to make this elbow, was forced by the winds to make it; and the sailing directions indicated that there probably would be an elbow here. The "Memnon," (Capt. Joseph R. Gordon,) crossed the Line in 19 days; she had no difficulty in clearing Cape St. Roque, and made a fine passage.

It was the same case with the "Surprise," (Captain P. Dumaresq;) with the "Seaman," (Captain Joseph Myrick,*) and with the "Dragon," Captain Andrew. They had to the equator 22, 20, and 24 days

* — *Letter from Captain Myrick.*

San Francisco, *March 28th*, 1851.

"Dear Sir:—In compliance with my obligation, I herewith enclose Abstract Log of ship Seaman, from New York to this port.

In regard to the comparative passages of other vessels to the equator, I have no means of informing you; as there have arrived only two vessels since I have been here, which sailed near the time of the Seaman's leaving; and those two vessels, (Helena and Hazard,) though they arrived here after me, they sailed from New York three or four weeks before me.

In respect to your route, it is THE track for all smart sailing ships to pursue, and I shall hereafter never think of following any other.

It is much to be regretted that so little is known to the general navigator of winds and currents in the North Pacific; as I find many

respectively. And it is remarkable how the tracks of these vessels, and all others that have followed these sailing directions, have conformed in their windings and irregularities to the tracks of the charts.

See the place at which all four of these vessels crossed the parallel of 5° N., to the place where they crossed the Line; it is very nearly a direct South course, as represented by the tracks with the arrows, generally for winter and spring; and as before remarked, the lines which represent the tracks for these months do not represent the tracks which it is possible for one ship in 100 actually to make, but they represent the mean or average track, which 100 ships sailed by navigators that never were wrong, would make.

Let us turn now to Plate XII, which is an illustration of the summer and fall routes.

This is the season of the year in which short passages are the most difficult by any route, old or new.

Track *x* is the track of a ship that had the charts on board. The Captain of that ship, judging from the track that he made, evidently undertook to set up his "own experience" against the experience of the thousand of navigators who had gone before him, all of which the charts held, spread out before him.

The track of the brig "Acasta" is given as an illustration of an attempt often made to "split the difference" between the old and new route.

She sailed from Sag Harbor, September 20th, 1850; went as far as 22° W., and crossed the Line in Long. 26°—November 14th—55 days. She got the "doldrums" in about 11° N., and they stuck by her for 15 days, and until she reached 2° N.

The fragment of the track *w*, illustrates the case of a vessel that attempted the new route, and abandoned it when she fell in with the equatorial "doldrums" in 11° N.—September 25th, 1850. She was going on very well, but here she met the southerly monsoons which the charts warned her of at this season of the year. The

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vessels have made long passages in consequence of not knowing the proper place to cross the Equator, and how to take advantage of the wind, when they lose the N. E. trades near the California coast.*

I cannot close without making the acknowledgment, that I consider myself indebted to your "Wind and Current Charts" for the short passage I have had from New York to this port; as I passed through all the tropical latitudes without any calms, and was in latitude of the river Plate, in 35 days from New York; which run I consider rarely, if ever, equalled."

* I have at the moment of going to press received another of the admirably kept abstracts of Captain Myrick. It is the log of the clipper ship "Seaman's Bride" from New York to California, where he arrived 19th May, 1852. He crossed the Equator in the Pacific in long. 104° W. He was 9 days thence, through the equatorial doldrums, to the parallel of 11° N., long. 110° W. He says: "I am determined never again to cross the Equator to the eastward of 110°, as we have been fighting calms, squalls and baffling winds from lat. 3° N. to 11° N., when they might, I think, have been avoided by crossing to the West." He had 26 days from the Line to San Francisco. He lost the N. E. trades in 33° Long. 135°, and was 4 days thence to port. Now had he crossed the Equator to the West of 110°, he probably would not, my researches show, have found the belt of equatorial doldrums, for this month, any narrower or less difficult to cross. He would probably have been forced by the N. E. trades off to the northward or westward several degrees further than he was when he lost them, and the difficulties then of getting to the eastward in the Horse Latitudes and variables of the Pacific, would have been nearly as great as those of the "Equatorial Doldrums." So the chances are that he would have gained not more than a day or two by crossing to the West of 110°.

The "Great Britain," Captain Caldwell, a ship 25 years old and a dull sailer, crossed the Equator in the same place, just one week after the "Seaman's Bride." The "Great Britain" carried the S. E. trades up to 7° N. Between that parallel and 8° N. she was in the "doldrums" for two days. Then taking the N. E. trades in 112° W., between 8° and 9° N., she carried them to 27° N. in 129° W. She was 7 days fighting light airs and calms in the "Horse Latitudes," between the parallels of 27° and 29°. She crossed them without going west of 130° W., and from that meridian and the parallel of 30° N, was six days in to port. She had in all 30 days from the Line to San Francisco, and 138 days at sea from New York. Considering the sailing qualities of the "Great Britain" and the "Seaman's Bride," Caldwell's passage of 30 days from the line, is just about equal to Myrick's of 26—Caldwell is very well satisfied with his crossing.

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wind came out S. S. W., and she went on fanning to the eastward and to *leeward*. From this place, it took her 16 days to reach the Line.

Such cases as these are common :—the errors are generally committed by standing too much towards the old track.

Sometimes, though rarely, vessels make mistakes by going on the other extreme. I find an example of this sort in the case of the U. S. ship "Vincennes," Commander Hudson, on a voyage from New York to Rio, in 1849.

She had the "Wind and Current Charts" on board, and claims to have taken them for her guide. But I have not been able to reconcile the course pursued by her with the route recommended.

To enable others to judge for themselves in her case, and to profit by her example, I shall quote her Abstract Log, which has been copied by Passed Midshipman J. J. Hanson, U. S. Navy, from the smooth Log returned by her to the Bureau of Ordnance and Hydrography.

I take this occasion to request the navigators who are co-operating with me, not to use the abbreviations —as the "Vincennes" does—to describe the weather; nor to give any but compass courses for the winds. The reason of this request is, that with only two or three exceptions, all who send me their Abstracts give compass courses, and describe the weather in the "old fashioned way. And in dealing with such a vast quantity of materials, these departures from the general practice, always create more or less difficulty, and involve liability to error.

ABSTRACT LOG OF THE U. S. SHIP "VINCENNES," WM. L. HUDSON, ESQ., COMMANDER, BOUND FROM NEW YORK TO RIO DE JANEIRO.

Date.	Latitude at noon.	Longitude at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	Ther. 9 a.m. Air.	Ther. 9 a.m. Water.	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
1849 Nov. 13	—		—	—	—	—	—	—	—	—	At 3.30, Sandy Hook Light bore N. W. by W., dist. 11 miles.
14	38°50′ N.	71°28′W.	—	—	30.30	58°	63°	W. by S.	S. W.	W. S. W.	b,
15	37 06	68 32*d*	8, N. E. ½ E.	6°45′W.	—	64	72	W. S. W.	N. W.	N. E. by N.	First part b, latter part b. c.
16	34 37	65 50	13, S. 28° W.	—	30.20	64	72	E. N. E.	E. N. E.	E. by N.	" c, " o, n.
17	33 52	65 26	24, N. ¼ E.	—	30.17	69	72	E. by N.	E. ½ N.	E. by N.	" c. " o, q.
18	34 14	65 20	—	—	30.08	70	72	E.	E. S. E.	S. E.	" o, q, " d, o, q.
19	35 12	64 11*e*	For two days	—	30.30	72	72	S. S. E.	W.	W.	" b, c, " b.
20	33 36	61 03	20, E. 32° N.	8 W.	30.20	72	72	S. W.	S. W. by S.	S. W. by S.	" b, " b.
21	32 43	58 03	—	8 30 "	30.18	72	72	S. by E.	S. by W.	S. W. by S.	" b, c, " c.
22	31 56	55 59	—	—	30.18	69	73	S. S. E.	S. S. E.	S. W. by S.	" c, r, " b.
23	31 18	54 48	—	—	30.18	72	74	W. S. W.	W. N. W.	N. N. W.	" b, " b, c.
24	30 00	53 47	18, W.	6 W.	30.18	73	75	E. N. E.	N. E.	N. E.	" b, c, " b, c.
25	28 00	51 55	7, W.	8 "	30.16	72	77	N. E.	N. W.	S. S. W.	" b, c, " b, c.
26	26 17	50 59	10, W. S. W.	10 "	30.22	72	76	S. E.	E. S. E.	E. S. E.	" c, r, " b, c.
27	23 38	50 56	12, W. 28° S.	10 "	30.15	77	76	E. by S.	E. S. E.	E. by N.	" b. " b.
28	20 54	50 43	18, W. 41° S.	9 "	30.25	77	80	E. S. E.	E. by S.	E. S. E.	" b, c, " b, c.
29	18 56	49 58	—	—	30.25	73	79	N.E. by E.	E. N. E.	E. S. E.	" c, " c,
30	16 24	49 56	—	6 W.	30.25	78	78	E. by N.	E. S. E.	E. by S.	" c, " b, c.
Dec. 1	13 48	49 31	20, S. W. ¼ S.	4 "	30.23	80	82	E. by S.	E. by S.	E. by S.	" b, c, " b, c.
2	11 22	48 27	19, S. 41° W.	2 "	30.20	75	79	E. N. E.	E. N. E.	S. E.	" c, q, t, " c, r.
3	10 11	47 53	16, S.	None.	30.20	77	81	E. S. E.	E.	E. N. E.	" c, " b, c.
4	8 48	47 17	11, S.	2 W.	30.20	80	82	E.	E. S. E.	E. by N.	" b, c, " b, c.
5	8 53	46 55	20, W.	None.	30.20	78	80	N. E.	E.	E. S. E.	" b, " b, c.
6	9 45	46 30	12, N.	None.	30.22	82	80	E. by N.	S. W.	S. E.	" b, " c.
7	10 04	46 18	13, N. 20° W.	1 10 W.	30.20	81	82	E. S. E.	E. by S.	E. S. E.	" b, c, " b.
8	8 16	45 46	—	—	30.19	82	82	E.	E.	E.	" b, " b, c.
9	8 17	45 15	For two days	—	30.28	76	80	E. S. E.	E. S. E.	S. E. by E.	" o, c, r, " c, q.
10	9 01	44 38	39, W. 23° N.	—	30.25	80	80	S. E.	E. by N.	E.	" b, c, " b, c.
11	6 10	43 37	12, S. by E.	—	30.25	77	82	E. by N.	E.	E. by S.	" b, " b, c.
12	3 55	43 59	18 S.	—	—	77	81	E.	E. by S.	E. by S.	" b, c, " b, c.
13	2 09	42 49	—	—	30.24	84	82	E. S. E.	S. E. by E.	E. S. E.	" b, " b, c.
14	0 23 S.	43 33	57, W. 14° N.	—	30.23	82	80	E. by S.	E. S. E.	E. S. E.	" b, c, " b, c.
15	1 30 N.	43 36	60, W. 33° N.	—	30.23	82	81	E.	E. by S.	E. by S.	" b, c, " b, c.
16	3 46	42 27	25, N. 22° E.	—	30.22	81	80	E. by S.	E. S. E.	E.	" b, " b, c.
17	4 11	41 27	—	—	30.24	74	79	E. by N.	N. E. by E.	E. N. E.	" o, d, " b, c.
18	3 29	41 49	17, N. 35° W.	—	30.24	81	81	E.	E. by N.	E. N. E.	" b, c, " b, c.

ABSTRACT LOG OF THE U. S. SHIP "VINCENNES"—CONTINUED.

Date.	Latitude at noon.	Longitude at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	THER. 9 a. m. Air.	THER. 9 a. m. Water.	WINDS. First Part.	WINDS. Middle Part.	WINDS. Latter Part.	REMARKS.	
Dec. 19	2°34′ N.	41°10′W.	10 W. by S.	—	30.24	85°	83°	E. N. E.	E.	E.	First part b, c,	latter part, b, t.
20	3 35	41 04	10 W. 13°S.	—	30.23	81	82	E. by S.	E. by N.	E. by N.	" b, c,	" b, c.
21	5 18	40 41	—	—	30.22	78	82	E.	E.	E. S. E.	" c,	" c, m.
22	6 21	40 39	—	—	30.23	79	80	E. by N.	E. N. E.	E. S. E.	" b, c,	" c, r.
23	5 52	39 04	—	—	30.25	80	80	E. N. E.	N. E. by E.	N. E. by E.	" c,	" c.
24	4 20	37 30	For two days	—	30.24	75	80	E. N. E.	N. E. by N.	E. S. E.	" c, r,	" b, c.
25	4 50	37 23	56, NE by E½E.	—	30.22	77	80	E. by S.	N. E. by E.	N. E. by E.	" b, c,	" b.
26	4 17	35 33	—	8°23 W.	30.23	79	80	N. E. by E.	E. S. E.	E. by S.	" b, c,	" b, c.
27	3 58	35 23	—	—	30.20	78	80	E. S. E.	E. by N.	E. by S.	" b, c,	" b, c.
28	4 20	35 07	—	8 30 W.	30.27	76	80	E. N. E.	S. E.	S. E. by S.	" c, r,	" b, c.
29	4 54	34 46	23, N. 15° W.	8 30 "	30.28	80	81	S. E.	E. N. E.	E. N. E.	" b, c,	" b, c.
30	4 01	33 32	9 N.	8 30 "	30.26	80	82	E.	E. S. E.	E. by S.	" b, c,	" b, c.
31	4 54	33 21	23, N. by W.	8 30 "	30.32	83	82	E. by S.	E. by S.	E.	" b, c,	" b, c.
1850												
Jan. 1	4 39	32 45	19, N. by W.	9 "	30.33	79	81	E. N. E.	E. N. E.	E. S. E.	" c, r,	" c.
2	3 50	32 04	—	—	30.31	76	81	E. N. E.	E. N. E.	N. E.	" c, r,	" c.
3	3 13	31 24	14, S. 47° W.	—	30.36	80	81	E. N. E.	S. E. by E.	S. E. by E.	" c,	" b, c.
4	3 52	30 52	35, W.	9 W.	30.34	85	82	S. E. by E.	S. E.	E. S. E.	" b, c,	" b, c.
5	3 22	30 53	21, W. ¾ S.	9 "	30.34	79	81	E. by S.	E.	E. by S.	" c, r,	" c.
6	2 47	31 05	39, W. 20° S.	9 "	30.35	77	80	S. E.	S. S. E.	E. S. E.	" c,	" c, r.
7	2 57	30 54	25, N.	9 "	30.34	76	80	E. S. E.	E.	Calm.	" c, r,	" b, c.
8	2 59	30 25	11, N.		30.34	77	80	S. W.	E. S. E.	S. W.	" b, c,	" b, c.
9	2 16	30 44	—	11 W.	30.34	77	81	E. by S.	S. E. by S.	S. by E.	" b, c,	" b, c.
10	2 30	30 21	26, 38° N.	11	30.34	80	80	S. S. E.	S. by E.	S. S. E.	" b, c,	" b, c.
11	1 45	30 18	23, N. 45° W.	—	30.32	79	80	S. S. E.	S. S. E.	S. E. by S.	" b, c,	" b.
12	0 26	30 51	36, W. 26° N.	—	30.34	80	80	S. E. by S.	S. by E.	S. E. by S.	" b, c,	" b.
13	1 26	29 48	48, W. 36° N.	—	30.34	81	81	S. by E.	S. by E.	S. S. E.	" b,	" b, c.
14	0 01	31 14	36, W. 35° N.	—	30.35	80	80	S. S. E.	S. by E.	E. S. E.	" b,	" b.
15	2 09 S.	31 25	12, N. 20° W.	—	30.35	78	80	S. E. by E.	S. E. by E.	S. S. E.	" b,	" b, c.

The "Vincennes" came out of Sandy Hook, November 13th, and had the wind out from the westward till the 15th, making a fine run to *d*, as per Plates XI and XII.

On the 18th the wind came out from the South, and continued there, or with westing in it, for a week, and then it hauled to the North, or so as to be mostly fair, for two days more. I have marked this place *e* on the chart, and in the log.

With these fine winds, what was that ship doing for this whole week? Why, actually hugging a S. W. wind, or standing as though she wanted to go to the West Indies.

She reached the Line the first time, it's true, in 30 days from New York, but too far to clear Cape St. Roque.

The track of the "Vincennes" beautifully proves the correctness of the charts; it conforms in its general direction to the track of the charts, but it is too far off. Any one who will examine the Log of that ship—her track, and my Sailing Directions—will see that it would be just about as reasonable for that ship to have gone over to the Cape de Verdes, (which would have been not quite as far on the other extreme,) and then meeting with a long passage of 60 days, to ascribe it to the charts. The ship whose track I have marked *x*, might, with the same propriety, ascribe her long passage to the charts also.

Navigators often follow the new route bravely, until they get into the equatorial calms; here their heart seems to fail them, and they bolt at the very time when they should stick more closely to their guide.

The region which these calms usually include is in the shape of a wedge; it shifts about, but Plates XI and XII show its mean place at the four seasons. In each season, it is sometimes above and sometimes below the place assigned it on the chart. But I have drawn it there to show navigators how they mistake, when being as far West even as 31° or 32°, they fall into these calms, and think of making longitude by fanning along to the eastward or an E. N. E. or perhaps a N. E. course. The farther they go on such occasions, the broader grows the belt, and the greater becomes the difficulty of getting across it.

I have projected on Plate XII, by a dotted line, the track of a ship, and marked it *y*, as an illustration of bad management under such circumstances, though it is by no means an extreme case. This ship had 40 days to the Line, took the new route, and followed it bravely until she reached the equatorial calms, in longitude 29°. She was then far enough to the eastward, and should not have been afraid to cross the Line as far West as 32°. But instead of proceeding to make the best of her way across this belt where it was narrow, and where two or three days at most would have sufficed for crossing it, she proceeded to flap along to the eastward as far as 21°; and thus, in consequence of the monsoons, found herself to *leeward*. When at *h*, that ship should, instead of making about an E. by S. course, have stood on the other tack, making the best of her way South, and not caring to get east of 30°. She might have been content to keep herself between 29°, or 30° and 31° or 32°, while she crossed these calms.

I have not yet found a single case in which there has been, after crossing the Line as far as 32°, the least difficulty in clearing St. Roque. Navigators should not hesitate, if they are pinched, to go inside of Fernando do Norhona. I have the track of one vessel that dashed on, crossed the line in 41° the 19th day out, and

on the 32d day was south of the parallel of Rio. This, though, was in the winter and spring when vessels can afford to keep to the westward, and it was going further West than I should advise.

But suppose a vessel to cross in 32° or 33°, and to get the S. E. trades at S. E. By standing on S. S. W., she keeps herself in a position in which any change of wind is favorable. If it haul to the eastward, she can lay up and clear the land; if it haul to the southward, she can go about and make easting, and get along rapidly by stretches upon long and short legs.

The current so much dreaded off St. Roque is a good deal of a bug-bear. Navigators have been frightened at this current ever since some transports were cast ashore by it, sometime in the last century. But it should be borne in mind, that it was quite as much of an undertaking for the clumsy transport-built ships of England in the last century, to contend against a current of one knot, as it is now for one of our first-rate sailing clipper-built ships, to contend with one of 4 or 5 knots.

The Log-book of the "Celia", quoted in the 3d edition of this work, is an example. It would have been impossible for that ship to beat against a one-knot current. In the days of this wreck, the passage from England to India averaged nine months. Warren Hastings, when he went out was 10 months on the way. The passage is now often made by our ships in less than 3 months. Therefore the ships of those days might be well cautioned against currents as dangerous, which the ships of the present day would scarcely regard.

Now, my investigations show that there is rarely off Cape St. Roque, aud in the fair way from the equator South, either a sweeping or a horsing current. Indeed many accurate and close observers pass there without reporting any current at all; and though navigators should always be on the look-out for a current there, and should always make allowance for one that is to set them on the land; yet when they do encounter a current there, they may be assured, that as a general rule, it is neither difficult to overcome nor dangerous on account of its set.

The schooner "Anna Sophia," J. T. Tuthill, sailed from Greenport, New York, for California, December 24th, 1849. She had the charts on board; claims to have followed them, and had a long passage. Vessels by following the charts may have a long passage, as they sometimes do over all parts of the ocean. But I am not disposed to permit navigators to commit blunders, and ascribe the consequences to the charts.

The "Anna Sophia" was evidently not a smart vessel; she had a passage of 9 months to California including the stoppage at St. Catherine's of one week.

She crossed the Line in about 31° 30′, fell to leeward, and was a month in getting clear of St. Roque.

I quote so much of her Abstract as relates to her track between the Line and Cape St. Roque.

Abstract Log of the Schooner "Anna Sophia," J. T. Tuthill, Master, bound from Greenport, N. Y., to California, 1849.

Date.	Latitude, at noon.	Longitude, at noon.	WINDS. First Part.	WINDS. Middle Part	WINDS. Latter Part.	REMARKS.
Feb. 8	0°30′ N.	31°28′ W.	S. E	S. E.	S. E.	Current 1 W. N. W. Lots of birds.
9	0 41 S.	32 20	"	"	"	
10	2 02	33 07	"	"	"	Current 1 W. N. W.
11	3 34	33 50	"	"	"	Fair weather.
12	4 07	33 20	"	"	"	
13	4 44 ☞	36 10	"	☞E.	E. N. E.	Sounded in 5 fathoms water on the banks of St. Roque—water green. Current 1½ W. N. W.
14	4 03	36 19	☞E.NE.	E. N. E.	E.	Standing in to 2 fathoms and off soundings.
15	4 37	36 07	S. E.	S. E.	"	" " "
16	4 32	35 48	E. N. E.	"	S. E.	Standing off and on.
17	4 55	35 34	E.	"	"	
18	4 29	35 40	"	"	E.	
19	4 43	35 38	E. N. E.	"	S. E.	Gaining to windward slowly.
20	4 56	35 38	E. S. E.	"	"	
21	5 00	35 39	"	"	Calm.	Nearly 1 month gaining 1½ of longitude and two degrees of latitude; which is the result of falling in to leeward of Cape St. Roque. When I cross the Line again in this direction, I shall probably aim to cross it in the longitude of 26° West, instead of 28° or 30° as recommended in this work. (Signed) J. T. TUTHILL.
22	4 02	35 26	E.	"	S. E.	
23	4 48	35 36	E. S. E.	E.	"	Standing off towards the Line.
24	4 03	35 00	E.	"	"	
25	2 56	34 00	S.E.by S.	S. E.	"	
26	1 54	32 48	E. N. E.	E.	E.	
27	1 03	31 40	S.E.by S.	S. E.	S. E.	
28	1 43	22 10	S. E.	"	"	
Mar. 1	2 50	33 17	"	"	"	
2	3 21	33 40	"	"	"	
3	3 08	33 58	"	"	"	
4	3 57	34 03	S.E.by S.	S.E.by S.	S.E.by S.	Standing southerly again.
5	5 00	34 47	"	"	"	Sounded in 15 fathoms—water green.
6	5 20	35 12	"	"	"	
7	5 27	35 07	S. E.	S. E.	S. E.	
8	5 48	35 05	"	"	"	

With this abstract before the navigator comment is unnecessary. Why should Captain Tuthill, on the 13th of February, have run off before the wind? On the 12th, he was in 4° 7′ South, and 33° 20′ West, Cape St. Roque bearing S. W. by W., with the wind at East, or E. N. E. for most of the 13th and 14th! He, therefore, could have laid up all this time to the southward and *eastward;* but instead of that, he ran for one whole day about W. S. W., with the wind *dead* aft, and Cape St. Roque on the port bow. He made on this course nearly 3° of westing, viz: from 33° 20′ to 36° 10′.

It is obvious to every one, that this schooner met with no difficulty in consequence of taking the new route, and of crossing the Line in 32°; had she stood to the southward on the 13th, she might have gone with the wind free by Cape St. Roque, passing out of sight of it to windward; for with the wind at East and to the North of East, she could have gone South as easily as West, and by making on that day 3° of latitude, instead of 3° of longitude, she would on the 13th have crossed 7° South, and been in the "fair way" to Rio and ports beyond.

Captain N. A. Bachelder, of the barque "Imaum," sailed from Salem to San Francisco, October 16th, 1850. He also had the Charts on board, took the new route, crossed 5° N. in 34° W., and the Line in 35°, after a fine run of 31 days. He stood on for three days more, and until he reached 4° 10′ S., in 35° 13′ W., meeting no *current*. But instead of taking advantage of the slants (the wind varying from E. by S. to S. E. by S.) or of making short and long stretches—as to the advantages of which I have so earnestly endeavored to impress navigators when they happened to be pinched here—he stood on, amidst all this veering and hauling of the wind, (except for twelve hours, the day he crossed the Line, when he steered N. E. by E.; and again, in latitude 4° S., longitude 35°, when he stood four hours N. E.) Finally he put about, stood to the northward and eastward, and reached the Line again, after an absence of seven days, in 31° W., from which position he cleared St. Roque, without difficulty, passing about 2° to windward of it. In ten days from the line this time, and in seventeen from his crossing it the first time, he was south of Rio. Thus making the passage, notwithstanding the falling to leeward, and losing a week in consequence, in eight or ten days less than the average time by the old route.

Indeed I have no doubt but that his difficulty, as it was, in getting by St. Roque, was less than it would have been in clearing the equatorial "doldrums," had he taken the old route.

With regard to the current of St. Roque, he remarks: "This" (meeting a current of 20 miles N. W. by W. in latitude 2° 17′ S., longitude 34° or 35° W.) "this is the first time for six days in which I have experienced the least current." He had then been down to St. Roque, and was on his way back to the Line. And to show that that much dreaded current is not always in motion here, he continues, "and on my way, last voyage to California, the N. E. trades failing me, I was obliged to cross the equator in longitude 32° 30′, November 20, 1849, in three days cleared Cape St. Roque with little or no current."

For the guidance of navigators who follow the new route, and are pinched in clearing St. Roque, as they no doubt will occasionally be, I repeat the following suggestions:

From the Line in longitude 33° Cape St. Roque bears S. S. W. From this crossing place, in a smart ship that will fetch where she looks, a S. E. wind all the way from the Line, would just prevent the vessel from clearing. But the chances are more than a hundred to one, that the wind will not hang steadily at S. E. all the way from the Line to St. Roque. If it haul to E. S. E. you can lay up and clear. If it haul to S. S. E. you can put about and make easting.

But suppose the wind holds steadily at S. E. or at any other point which will prevent you from clearing the Cape; draw a line from your place on the Chart to the Cape, and avoid falling to the west of that line, by taking advantage of slants, or by beating, accordingly as you may have the wind, and making long and short stretches. I quote the case of the "Stag Hound," as an example.

Captain Richardson to Lieutenant M. F. Maury.

"San Francisco, *June* 12, 1851.

"Herewith I send you abstract of ship "Stag Hound's" passage from New York to San Francisco, stopping

at Valparaiso. Our passage from New York to Valpariaso was sixty-six days; from Valparaiso to San Francisco was forty-two days—nearly all the way light trades: S. E. and N. E.

"Six days out from New York, broke off main topmast, and that in its fall took all three topgallant masts. Soon after took a W. S. W. and West gale—run the ship dead before the sea and wind: in consequence of this, crossed the equator in about longitude 28° 30′ W. in twenty-one days from New York. Losing topmast, we had no main topsail in the ship for nine days, and no topgallant sails for twelve days; had we not met with this accident, I think we should have been down to the Line in sixteen days.

"In latitude 4° N. the N. E. trades left us, then baffling down to latitude 2° N. Then took the wind at S. S. E. and S. E., until near the coast of Brazil, when the wind hauled so we did not have to make a tack; presume had we crossed in longitude 30° W., we should have fetched along the coast."

This letter of Captain Richardson is quoted as an illustration of what I have endeavored to impress upon navigators, with regard to their course, after crossing the Line well to the westward, and when it appears to be touch-and-go as to clearing St. Roque, viz: stand boldly on, and take advantage of slants and short legs, to make long ones.

I received the abstract of another vessel about the same time that crossed in 31°, and I notice in the remarks after crossing the line—"back strapped"—"no chance of weathering Cape St. Roque"—"shall evidently fall to leeward," "bad luck," &c. Yet this desponding navigator stood bodily on, took advantage of a slant, stood off for eight hours, went passed St. Roque like a shot, and the thirty-second day out from New York, crossed the parallel of Rio.

During the last year (1851) the average passage to Rio of the ships that have used the charts, has been about 35 days, showing a clear gain upon the old route of nearly three weeks.

That vessels will sometimes meet with unfavorable winds by this as they will by all routes, I need but quote as an illustration the Log-book of the barque "Mermaid," bound from Boston to San Francisco, May, 1851.

It will be observed that that vessel did not get the N. E. trades at all, except for one day; and that notwithstanding, that after reaching the region where she ought to have found the N. E. trades, she found the winds for the most part south of east, yet she had no difficulty in crossing the Line in 30°; and moreover, that notwithstanding she was dismasted in 1° S. 31° W., she had no difficulty, even under these circumstances, of clearing St. Roque, and of arriving at Pernambuco 36 days out.

I have heard of such puffs of wind about Para as dismasted the "Mermaid," but never in this region before. There was a vessel of war some years ago, in the mouth of the Amazon, that had her forward sails and some of her spars carried away by one of those "puffs" when there was not wind enough aft to fill the mizzen topsail. Such "whiffs," I understand, are not unfrequent about the mouth of the Amazon.

ABSTRACT LOG OF THE BARK "MERMAID," GEO. J. O. SMITH, COMMANDER, BOUND FROM BOSTON, MASS., TO SAN FRANCISCO, CAL. 1851.

Date.	Latitude, at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation observed.	Bar.	Ther. 9 A. M. Air.	Ther. 9 A. M. Water.	Winds; First Part.	Winds; Middle Part.	Winds; Latter Part.	Remarks.
1851. May 12								S. E.	S. E.	S. E.	Monday, May 12th: Started in tow of a steamer at 9 A. M.—at meridian Minot's Ledge bore S. W. by W., (Mag.) distance 8 miles.
13	42°10′ N.	67°40′W.	Regular tides.	No. obs.	30.00	42°	40°	S. E.	S. S. E.	S.	Fresh winds, accompanied with fog and smooth sea
14	40 42	62 53	Slight easterly.	do.	29.85	60	58	S. S. W. to		S. W.	Strong winds, with thick weather. In the Gulf Stream.
15	39 44	58 17	1 knot N. E.	do.	29.85	68	59	S.	to	S. W.	Strong winds and irregular swell running. In the Gulf Stream.
16	38 10	53 53	Easterly.	do.	29.85	70	60	S. W.	S. W.	S. W.	Strong gales—all light sales furled—latter part of this day rained in torrents for four hours from S. W.—at noon calm.
17	37 01	52 10		do.	30.05	72	67	N. W.	N. E.	Calm.	Light winds from N. W. fresh and squally from N. E.—calm.
18	37 00	49 57		do.	30.15	72	67	S. S. W.	S. S. E.	S. S. E.	Light winds from S. S. W.—Fresh from S. S. E. with clear sky: Saw this morning gulf-weed for the first time since we left port: During this day made tacks to the S. S. W.
19	36 26	49 10		do.	30.10	74	67	S. S. E.	S. S. E.	S. E.	First part of the day had pleasant winds from S. S. E.—middle part moderate—latter part from S. E. and moderate.
20	35 20	49 03		do.	30.10	76	67	S. S. E.	S. S. E.	N. W.	First and middle part light airs from S.S. E.—latter part breezes from the N. W., being calm for 2 hours previous to the N. W. wind.
21	33 06	46 51		do.	30.15	77	68	N.	N. N. E.	N. E.	First part pleasant winds from N. W.—middle part from N. N. E.—latter, N. E. and fine weather.
22	31 24	44 56	N. E. 36 miles.	N. 14 02 W.	30.05	78	68	N. N. E.	N. W.	N. W.	First part fresh winds from N. N. E.—middle part from N. W.—latter part calm: Large quantities of gulf-weed floating.

May 23	29°51′ N.	43°42′W.	East 18 miles.	No. obs.	30.10	7 °	70°	N. W.	N. N. W.	N. N. W.	First part light winds from N. W.; middle part rain squalls from W.; latter part light winds. Gulf-weed about.
24	29 05	43 00	East 12 miles.	do.	30.15	78	72	N. W.	N. W.		Light unsteady airs from the westward through the day.
25	28 25	42 11	East 12 miles.	do.	30.10	78	72	W. S. W.	S.W. to E.	S. W. to E.	First part light winds from W. S. W.; middle part calm and baffling; latter part light airs from S. W. Observed tide rips; latter part midnight stars shooting from S. S. W. to N. N. E.
26	28 00	41 32	East 12 miles.	16 10 W.	30.20	82	72	S. W.	W. S. W.	S. W.	Throughout this day have had light baffling airs from the S. W. with a smooth sea; observed lightning from E. to S. W.
27	28 00	41 16	East ½ knot.	15 39 W.	30.30	84	73	W. S. W.	Calm.	Calm.	First part light winds from W. S. W.; middle and latter part calm and no appearance of a breeze; the sun powerfully hot.
28	27 57	41 22		14 50 W.	30.25	85	74	Calm.	Calm.	Calm.	Calm through this day, not having a breath of wind.
29	27 28	41 00			30.20	80	74	Calm.	Calm.	S. W.	First and middle parts calm: at 9 A. M. a breeze sprang up from the S. W.
30	26 13	39 39		14 25 W.	30.20	80	76	S. W.	North and squally.	S. W.	First part light breezes from the S. W.; middle part squally from the northward; latter, light winds from S. W.
31	24 40	37 56			30.25	82	77	S.W.byW.	S. S. W.	S. S. W.	First part light winds from the S. W. by W.; middle and latter parts light winds from S. S. W.
June 1	24 10	36 15			30.25	82	77	S. S. W.	S.	S.	First part light winds from S. S. W.; middle and latter parts very light airs from the southward.
2	23 00	36 27		12 56	80.25	80	73	S. S. E.	S. E.	E. S. E.	First part light airs from the S. S. E.; middle part light from the S. E.; latter part light from the E. S. E., the weather having the appearance of *trades*.
June 3	21 07	35 10			30.25	78	75	E. S. E.	E.	E. by N.	First part light winds from E. by S. —middle part, pleasant breezes; latter part, moderate—entered the trades.
4	18 32	33 30			30.25	78	75	E. by N.	E. by N.	E. S. E.	First and middle parts fresh winds from the E. by N.; latter part wind from E. S. E.

ABSTRACT LOG OF THE BARK "MERMAID"—CONTINUED.

Date.	Latitude. at noon.	Longitude, at noon.	Currents. (Knots per hour.)	Variation observed.	Bar.	THER. 9 A. M.		WINDS.			REMARKS.
						Air.	Water.	First part.	Middle part.	Latter part.	
1851. June 5	15° 29′ N.	32° 18′ W.			30.20	78°	74°	E. by S.	E. by S.	E. by S.	Through this day have had the wind from E. by S., squally from sunrise to sunset.
6	11 43	30 56			30.15	78	76	E. by S.	E.	E.	Through this day have had strong winds from the eastward, squally from sunrise to sunset.
7	8 23	29 46		9 30 W.	30.10	82	76	E.	E. S. E.	E.	Through this day the wind has been unsteady from the eastward—at midnight calm for 15 minutes.
8	6 05	28 50			30.10	83	76	E.	E. S. E.	N. E. to E. S. E.	Begins with light winds from the eastward—middle part light from the E. S. E.—latter part heavy squalls of rain, the wind baffling from N. E. to E. S. E.
9	4 50	28 42			30.10	81	76	E. S. E.	E. by S.	E. S. E.	Throughout this day have had light baffling winds from N. E. to S.W., tacking as the wind hauled—the wind principally or averaging as per column—a heavy rain squall this P. M.
10	4 27	28 40			30.10	82	75	S.	S. S. E.	E. S. E.	First part light winds and squalls from the southward—middle part from S. S. E.—latter. wind from E. S. E.—lightning in the S. E.—Ends with heavy rains.
11	2 18	29 10			30.10	84	75	S. E.	E. S. E.	E. S. E.	First part moderate; middle and latter fresh, accompanied with heavy squalls of wind and rain; likewise a heavy sea running from S. S. E.; ends calm.
12	0 18 S.	30 42			30.10	82	80	S. E.	S. S. E.	S. E. by E.	First part moderate; middle and latter parts fresh; a heavy sea on from the S. E. and S.
13	1 22	31 22			80.05	82	81	S. E.	E. S. E.	E. S. E.	First part fresh; at 9 P. M. the sea very irregular and high from S. E. and S.; in a sudden puff of wind from the southward carried away our jib-boom, fore-mast, and masts above it; laying in the trough through the rest of this day, laboring hard, being in an unmanage-

											able state. I have crossed the equator in all seasons, and never saw so much nor so irregular sea on; the puff lasted no more than to list the ship and dismast her; at 9 A. M. got steerage-way aboard, making for Pernambuco, calculating she made about a due *West drift*.
14	8 06	31 30			30.05	80	80	E. S. E.	E. S. E.	E. S. E.	Throughout this day have the wind from the E. S. E., interrupted by squalls of wind and rain from the southward.
15	5 03	32 19			30.00	78	80	S. E.	E. S. E.	S. E.	First part moderate; middle part squally; latter part moderate.
16	6 43	33 19						E.	S. S. E.	S. E.	Winds unsteady, with squalls from the southward.
17	8 30	34 00			30.00	80	80	S. E.	S. S. E.	S. E. by S.	Winds unsteady, with heavy squalls of wind and rain from the southward.
18	8 17	34 35			29.55	79	79	Baffling.	S. S. E.	S. S. E.	Standing in-shore for Pernambuco bay, and anchored in 5 fathoms: light bearing W. by N., distant half a mile, having been set to the N. W. 15 miles by the current. GEO. J. O. SMITH.

Mistakes in the route to Rio are, I am happy to say, becoming much less frequent. The charts are evidently much better understood now than they were formerly. Since the last edition of these "Sailing Directions" went to press, no such mistake as that of the "Vincennes," has come to my knowledge.

With a view of contrasting the passages of the new route, I have taken the logs of all the vessels that have come to hand between the publication of the fourth edition, and the going to press with the fifth edition of this work, and from them tabulated the passages to the equator, and thence to clearing Cape St. Roque.

The old route is nearly broken up. It is now rarely attempted. But many vessels evidently aim to "split the difference" between the *old route* and the *new*, by steering a sort of middle course between them. This I have called THE MIDDLE ROUTE.

Some of the vessels which take this middle route, evidently set out with the intention of trying the new route, but they get a little pinched; or the winds are too favorable; or the dread of that bug-bear off Cape St. Roque—a westwardly current—seizes them; or through fear of falling to leeward, of getting back-strapped, &c., they go too far east and get delayed in the "doldrums."

It will be seen, by consulting the Table, NEW ROUTE, pp. 400 et. seq., that the mean crossing place on the equator, by the vessels of the new route, is in 29° 55′ West:—that out of the 88 vessels there recorded, but two fell to leeward, both in October. They both crossed 5° N. in 37° W.: a smart ship, we may therefore infer, need not fear to cross the Line as far as 32° or 33° West, especially in the winter time.

Lieut. Kennedy, commanding the U. S. Store ship "Supply," on her recent voyage to Rio, mentions a striking instance of the advantage of sticking to the charts, and conforming to the sailing directions. He crossed in the month of February, 34 days out, in Long. 33° W. He was pinched, and made the land 7 miles to leeward of Cape St. Roque. He stood boldly on; took advantage of a slant, as recommended, and got by without any difficulty. The bark Polka, however, which was in company, stood off to the northward and eastward in order to get an offing, and pass to windward of the Island of Fernando do Noronha. This brig though a better sailer than the "Supply," did not arrive until several days after the "Supply." *

* *Extracts from Log of the United States Store Ship "Supply," Lieutenant C. H. Kennedy, commanding.*

January 6, 1850 (Lat. 39° N., Long. 63° W.) at 10 a. m. a whirlwind passed between our fore and mainmasts, doing no damage. At the same time, two others were observed, one on the port-beam, the other on the starboard quarter. Their formation was very sudden, giving no warning whatever of their approach; nor was the *force* or direction of the wind, which, at the time, was blowing fresh, in the least affected; the diameter of the one which passed between our masts was about ten feet with a rotary velocity of about one hundred miles per hour, and a progressive velocity of about sixty or seventy miles per hour. The one on the port-beam was much larger, carrying with it large quantities of water, and moving with a higher velocity.

February 6, 1850 (Lat. 1° 40′ N., Long. 32° W.,) at 3h. 30m. a large and heavy whirlwind passed across our bow, about two hundred yards distant, with a very high velocity, and carrying with it large quantities of water.

The ship did not sail well during the first part of the passage, having been stored out of trim, and griping to such a degree that all the sails on her mizzen mast were useless. I could not make any change in her trim by shifting weight from one extreme (a bad way at best) as every crack and crevice was crammed with stores, baggage, &c.

The first part of the passage was rough, and the south westerly winds drove me far out of my track. I was at one time apprehensive of being forced in sight of the "Cape de Verde Islands."

When the "trade winds" north of the Equator began to fail me, the weather became squally, and the wind light; though in general the squalls were of rain only.

On the 6th of February, however, we had some wind in them, and a violent whirlwind passed ahead of the ship about two hundred yards. It would have passed over the ship, had it not been met, and driven ahead of a squall.

The chief point of information as to the new route appears now to be in the practical answer to this question: Which is the best way of crossing the "equatorial calms?" The region most liable to these calms is, as I have before explained, wedge-shaped, with the point of the wedge directed towards South America.

The winds in these calm regions are often from the southward and westward; indeed, as you approach the coast of Africa in summer and fall, these southwardly winds assume the character of a regular monsoon.

The place of these calms varies too: it is sometimes at the equator; sometimes in 5°, 10°, or even in 15° North, according to to the season of the year.

And the answer to the question, "how to across them?" is this: Unless you are fearful of falling to leeward, or you are already too far to leeward and want to make easting in the southwardly winds of the "doldrums," do your best to make southing, for by that course you will clear them soonest. By that course you run directly across them; by an East or West course, you run along with them.

I was forced across the Line in Long. 32° 50′ on the 7th of February. To avoid being back-strapped, I stood to the East for twelve hours between the 8th and 9th, and twenty-one and a half hours between the 10th and 11th; but I am now inclined to believe that I might have fetched past St. Roque by standing on. On the 11th, stood in for the land, and made it on the 12th at 2 p. m. At 3h. 30m. tacked ship in a half twelve: shells and gray sand mixed with coral, which was the general character of the soundings every time we got bottom. Stood off shore; 4h. 45m. tacked and laid up along the land, which was again made on the 13th; stood in to ten fathoms, and tacked at 2h. 30m. p. m. "Cape Branco" bearing, per compass, S. by W. ½ W., distant about thirty miles, and the land abeam, distant about eight miles. At 9 p. m. tacked again and laid well up along the land, which we did not again see till we made "Cape Frio." The wind fanned us on both tacks, and when we "went about" the last time, we made a S. by E. compass course. Thus we cleared the land in two off-shore tacks, each of 5h. 30m, the current sweeping *along* or *off* shore. The distance run per log is six thousand five hundred and sixty-three miles. No vessel that sailed in January has yet arrived. We spoke the "Green Point" between 1° and 2° N. and 30° 54′ W. bound to Rio, she had sailed two days before us (January 1st) from New York. We also saw the bark "Polka" standing in for the land on the afternoon of the 10th Feb. We were on the opposite tack, having gone about to avoid the bight to the westward of St. Roque.

I have endeavored to obtain accurate information of the passages made in December, but the Register is so loosely kept that I can learn nothing more than the number of days of the voyage, not even the time of sailing or arrival, or the meridian on which they crossed the Equator.

NEW ROUTE.

Name of Vessel.	Sailed From.	Longitude of Crossing Parallels of— 30° N. Long. W. ° ′	25° N. Long. W. ° ′	20° N. Long. W. ° ′	15° N. Long. W ° ′	10° N. Long. W ° ′	5° N. Long. W ° ′	Crossed Equator. Long. W. ° ′	Crossed Equator. Days.	Passed St Roque Days.
	January.									
Diadem, - - - -	N. York, 1st	37 0	28 0	29 0	28 0	27 0	27 0	29 0	38	42
Black Squall, (Bark,) -	Baltimore, 8th	40 0	39 0	38 0	36 0	36 0	30 0	27 16	24	27
Great Britain, - - -	N. York, 9th	36 0	37 0	36 0	35 0	33 0	29 0	30 0	27	30
Miantonomi, (Bark,) -	N. York, 8th	45 0	44 0	44 0	41 0	40 0	38 0	30 23	39	43
	Means	37 40	34 40	34 20	33 00	32 00	28 40	28 45	32	35.5
	February.									
Kate Hays, - - - -	N. York, 3d	49 0	42 0	38. 0	34 0	30 0	29 0	28 40	29	33
Isabelita Hyne, (Bark,)	N. York, 5th	55 30	53 0	51 0	49 0	45 0	38 0	33 20	22	25
Wallace, (Bark,) - -	Boston, 6th	44 0	43 0	39 0	35 0	31 0	29 0	29 25	38	43
Francis, " - -	N. York, 12th	53 0	39 0	39 0	38 0	34 0	30 0	29 0	38	43
Eastern State, - - -	N. York, 13th	39 0	36 0	33 0	30 0	30 0	29 0	29 30	24	27
Sacramento, (Brig,) -	N. York, 21st	42 0	40 0	39 0	36 0	31 0	26 0	27	30	33
Maria, - - - - -	N. York, 21st	47 0	41 0	38 0	34 0	31 0	29 0	29 0	21	24
Ariel, - - - - -	N. York, 24th	38 0	34 0	32 0	30 0	29 0	28 0	27 20	32	35
Tornado, - - - -	N. York, 23d	47 0	40 0	38 0	35 0	32 0	30 0	28 48	28	31
	Means	44 52	39 22	37 00	34 00	31 00	28 45	28 35	29	32.5
	March.									
Stag Hound, - - -	N. York, 1st	40 0	32 0	32 0	27 0	27 0	23 0	28 0	26	29
Michael Angelo, - -	N. York, 6th	48 0	38 0	33 0	30 0	28 0	25 0	23 30	26	32
Sarah Boyd, - - -	Phila'd, 9th	42 30	37 0	34 0	32 0	31 0	29 0	28 0	32	38
Sea Serpent, - - -	N. York, 10th	47 0	41 0	39 0	35 0	32 0	31 0	29 30	18	23
Parana, - - - - -	N. York, 16th	36 0	31 0	30 0	29 0	28 0	28 0	28 15	24	26
Gov. Morton, - - -	N. York, 12th	43 0	38 0	35 0	33 0	30 0	29 0	28 0	26	31
Candace, (Bark,) - -	N. York, 25th	45 0	43 0	42 0	41 0	38 0	32 0	30 10	30	32
Kedar, " - -	Boston, 27th	39 0	32 0	30 0	29 0	29 0	29 0	29 30	40	44
	Means	42 34	36 30	34 22	32 00	30 22	28 52	28 07	27.7	31.8

NEW ROUTE.

Name of Vessel.	Sailed from	Longitude of Crossing Parallels of— 30° N.	25° N.	20° N.	15° N.	10°	5° N.	Crossed Equator. Long. W.	Days.	Passed St. Roque Days.
		Long. W	Long. W	Long. W	Long. W	Long. W	Long. W			
	April.	° ′	° ′	° ′	° ′	° ′	° ′	° ′		
Empire - - - - -	New York, 2d	40 0	34 0	35 0	35 0	32 0	29 0	28 40	26	30
Thos. B. Wales - -	Boston, 7th	42 0	39 0	34 0	33 0	30 0	29 0	28 0	26	30
White Squall - - -	N. York, 10th	38 0	34 0	32 0	31 0	29 0	28 0	27 0	21	24
Nestorian - - - -	N. York, 24th	36 0	34 0	35 0	33 0	30 0	27 0	29 32	31	35
Huma (Bark)* - - -	N. York, 25th	59 0	54 0	51 0	46 0	43 0	39 0	37 10	40	48
Hazard (Bark) - - -	Boston, 27th	39 30	38 0	37 0	34 0	31 0	28 0	28 30	25	27
North American - -	N. York, 3d	54 0	42 0	36 0	34 0	35 0	30 0	27 00	26	30
	Means.	44 04	39 17	37 09	35 09	32 51	30 00	29 24	27.9	32
	May.									
Staffordshire - - -	Boston, 3d	52 0	50 0	45 0	42 0	37 0	32 0	29 40	25	28
Robert Wing (Brig) -	Boston, 6th	41 0	39 0	35 0	33 0	31 0	28 0	29 55	31	34
Equator - - - - -	Boston, 9th	43 0	39 0	38 0	38 0	36 0	33 0	31 02	43	46
F. Copeland (Brig) -	Boston, 11th	43 30	39 0	36 0	34 0	32 0	29 0	32 0	37	40
Carioca - - - - -	Phila., 13th	43 0	39 0	37 0	35 0	32 0	27 0	32 0	35	40
Sea Breeze - - - -	Boston, 15th	44 0	40 0	40 0	39 0	37 0	32 0	30 0	35	38
Isabelita Hyne (Bark)	N. York, 21st	40 0	36 0	35 0	32 0	30 0	29 0	30 34	25	28
Albany - - - - -	N. York, 24th	39 0	37 0	35 0	33 0	30 0	27 0	27 30	42	45
	Means.	43 11	39 52	37 37	35 45	33 07	29 37	30 20	34.1	37 5
	June.									
Union - - - - -	New York, 2d	43 0	42 0	40 0	39 0	37 0	27 0	30 20	24	26
Flying Cloud - - -	New York, 3d	40 0	40 0	40 0	38 0	36 0	32 0	33 0	22	24
Russel (Brig) - - -	Salem, 6th	35 0	33 0	32 0	29 0	27 0	23 0	28 0	32	35
Cohota - - - - -	Boston, 17th	48 0	43 0	40 0	37 0	31 0	25 0	26 0	32	34
Valparaiso - - - -	N. York, 18th	35 30	35 0	35 0	32 0	31 0	27 0	31 41	34	37
Witch of the Wave -	Boston, 23d	51 0	50 0	49 0	47 0	44 0	38 0	33 25	27	32
Defiance - - - -	N. York, 26th	44 0	46 0	45 0	43 0	39 0	27 0	31 0	36	38
Miantonomi (Bark) -	N. York, 28th	45 0	43 0	41 0	40 0	36 0	26 0	32 13	36	40
	Means.	42 41	41 30	40 15	38 07	35 07	28 07	30 42	30.5	33 2

* Fell to leeward: therefore is not included in the means which are intended to show the *best average* crossings.

NEW ROUTE.

Name of Vessel.	Sailed from.	Longitude of crossing Parallels of— 30° N.	25° N.	20° N.	15° N.	10° N.	5° N.	Crossed Equator. Long. W	Days	Pas'd St. Roque. Days.
		Long. W ° ′	Long. W ° ′	Long. W ° ′	Long. W ° ′	Long. W ° ′	Long. W ° ′	° ′		
	July.									
Mermaid, (barque,)	N. York, 2d.	52 0	52 0	50 0	46 0	43 0	30 0	34 0	33 0	37 0
Telegraph,	N. York, 13th.	50 0	48 0	46 0	43 0	39 0	26 30	29 0	33 0	35 0
	Means.	51 0	50 0	48 0	44 30	41 0	28 15	31 30	33 0	36 0
	August.									
Raven,	N. York, 1st.	*34 0	34 0	34 0	34 0	33 0	26 0	31 0	33 0	35 0
Sea Witch,	N. York, 2d.	47 0	45 0	41 0	38 0	34 0	26 0	27 0	28 0	30 0
Typhoon - - - - -	New York, 3d	47 0	46 0	45 0	42 0	35 0	26 0	29 0	28 0	30 0
Seaman - - - - -	New York, 3d	40 0	39 0	38 0	36 0	35 0	27 0	31 51	29 0	31 0
Winged Arrow - - -	Boston, 5th	47 0	46 0	45 0	43 0	39 0	30 0	31 0	28 0	30 0
Raven - - - - -	Boston, 6th	†44 0	41 0	39 0	37 0	33 0	25 30	28 0	25 0	27 0
Cohota - - - - -	Boston, 11th	†44 0	41 0	39 0	36 0	29 0	28 0	24 0	29 0	32 0
Sovereign of the Seas -	N. York, 14th	34 0	34 40	34 50	33 45	33 0	27 10	36 0	25 0	28 0
Sea Witch - - - -	N. York, 23d	41 0	37 0	36 0	34 0	30 0	25 0	27 0	29 0	31 0
Oliver J. Hays - - -	N. York, 29th	43 30	41 0	39 0	35 0	34 0	30 0	28 0	51 0	54 0
	Means.	41 50	40 20	39 00	37 07	34 0	26 57	29 52	30 5	32 8
	August.									
Seaman - - - - -	New York, 3d	40 0	39 0	38 0	36 0	35 0	27 0	31 51	29 0	31 0
	October.									
Comet - - - - -	New York, 2d	45 0	41 0	37 0	35 0	32 0	29 0	31 0	25	27
Russell - - - - -	New York, 3d	41 0	36 0	33 0	31 0	29 0	26 0	28 12	36	39
Miantonomi - - -	New York, 3d	‡46 0	46 0	45 0	41 0	41 0	37 0	34 0	47	51
Somerset - - - -	Boston, 4th	51 0	44 0	38 0	35 0	31 0	29 0	30 25	43	46
Wild Pigeon - - -	N. York, 14th	40 0	36 0	32 0	31 0	32 0	28 0	28 0	27	29
Golden Gate - - -	N. York, 14th	40 0	36 0	32 0	32 0	32 0	27 0	28 0	27	29
Miguelon (Bark) - -	Salem, 15th	48 0	45 0	39 0	34 0	33 0	30 0	32 0	40	43
Helena - - - - -	N. York, 30th	50 0	44 0	40 0	40 0	40 0	37 0	32 10	39	45
	Means.	44 10	39 40	35 10	33 00	31 30	28 10	29 36	34	37

* Winds forced her to go too far East.

† Got S. W. monsoon, and went unnecessarily too far East.

‡ Not included in mean-crossings, because she fell to leeward.

NEW ROUTE.

Name of Vessel.	Sailed From.	Longitude of Crossing Parallels of—												Crossed Equator.			Passed St. Roque
		30° N.		25° N.		20° N.		15° N.		10° N.		5° N.		Long. W		Days.	Days.
		Long. W		Long. W		Long. W		Long. W		Long. W		Long. W					
	November.	°	'	°	'	°	'	°	'	°	'	°	'	°	'		
Celestial - - - -	New York, 2d	45	0	37	0	32	0	32	0	30	0	28	0	31	0	24	26
Newton - - - - -	Boston, 7th	42	0	42	0	41	0	40	0	38	0	35	0	32	30	34	38
Flying Fish - - - -	Boston, 7th	49	0	42	0	36	0	35	0	34	0	30	0	32	0	19	21
R. C. Winthrop - -	Boston, 8th	42	30	42	0	41	0	30	0	37	0	34	0	32	30	32	35
Sword Fish - - - -	N. York, 12th	44	0	39	0	37	0	36	0	35	0	31	0	32	0	23	25
Horatio - - - - -	N. York, 18th	44	0	33	0	31	0	30	0	29	0	29	0	30	30	25	27
Esther May - - - -	Boston, 19th	35	0	32	0	33	0	33	0	32	0	31	0	31	0	27	31
Lucia Field, (Bark) .	Boston, 20th	37	0	34	0	31	0	30	0	29	0	28	0	31	0	31	34
Geo. Brown - - -	Phila'd, 24th	41	0	35	0	32	0	30	0	28	0	28	0	29	0	29	34
Esther May - - - -	Boston, 19th	38	0	33	0	32	0	33	0	32	0	30	0	31	45	27	29
Uriel - - - - - -	N. York, 27th	45	0	39	0	36	0	33	0	31	0	29	0	30	00	26	30
	Means	41	20	37	55	34	44	33	44	32	16	30	16	31	12	27	30
	December.																
Southerner, (Bark) -	N. York, 1st	40	0	41	0	40	0	38	0	35	0	32	0	30	0	38	42
Hazard - - - - -	N. York, 4th	45	0	41	0	39	0	38	0	35	0	32	0	32	0	21	24
Samuel Russell - -	N. York, 5th	53	0	46	0	43	0	41	0	36	0	32	0	30	0	19	20
Element - - - - -	N. York, 5th	44	0	42	0	39	0	36	0	33	0	31	0	31	0	22	24
Grafton, (Bark) - -	N. York, 8th	35	0	31	0	33	0	32	0	32	0	30	0	29	0	29	31
Lantao - - - - -	N. York, 8th	44	0	41	0	41	0	41	0	37	0	31	0	29	0	30	32
St.Lawrence(U.S.frigate)	N. York, 12th	42	0	39	0	36	0	35	0	33	0	30	0	31	0	31	34
Seaman's Bride - -	N. York, 12th	41	0	40	0	40	0	36	0	34	0	30	0	31	0	28	32
Portsmouth, (U. S. Ship)	Boston, 16th	36	0	39	0	38	0	38	0	36	0	33	0	31	0	26	30
Hurricane - - - -	N. York, 17th	45	0	42	0	41	0	40	0	38	0	34	0	34	0	27	30
Benjamin Howard - -	Boston, 25th	41	0	35	0	33	0	32	0	29	0	26	0	27	0	25	28
Pontiac - - - - -	Boston, 25th	43	0	38	0	36	0	35	0	32	0	30	0	30	0	23	27
	Means	42	25	39	35	38	15	36	50	34	10	30	55	30	25	26.5	29.5

MIDDLE ROUTE.

Name of Vessel.	Sailed From.	Longitude of Crossing Parallels of— 30° N. ° ′	25° N. ° ′	20° N. ° ′	15° N. ° ′	10° N. ° ′	5° N. ° ′	Crossed Equator. Long.W. ° ′	Crossed Equator. Days.	Passed St Roque Days.
Boston, - - -	Boston, Jan. 1st	*32 0	28 0	27 0	26 0	25 0	23 0	24 50	27	31
Wiskonsin, - -	N. York, " 20th	*30 0	30 30	31 0	31 0	28 0	27 0	28 11	25	28
Vandalia, - - -	N. York, " 20th	*31 0	29 30	27 0	26 30	26 30	26 0	28 00	37	41
M. Hawes, - -	N. York, Feb. 22d	‡40 0	32 0	30 0	27 0	26 30	26 0	26 18	35	41
Rose Standish, -	N. York, March 1st	33 0	29 0	28 0	27 0	26 30	26 0	27 00	27	30
Ariel, - - - -	N. York, " 10th	33 0	31 0	30 30	29 30	28 0	26 30	26 26	30	34
Harriet Hoxie, -	N. York, " 24th	*30 0	26 0	28 0	28 30	29 0	29 30	30 20	27	30
Queen of the East,	N. York, April 8th	*31 0	27 0	27 0	26 0	25 0	23 0	23 00	31	36
Thames, - - -	Portland, " 24th	‡50 0	42 0	38 0	33 0	30 0	25 0	26 08	41	44
Rome, - - - -	N. York, " 26th	*32 0	30 0	30 0	29 0	26 0	25 0	26 00	43	46
Arthur Pickering,	Salem, " 30th	38 0	36 0	36 0	33 0	29 0	26 30	27 50	36	39
Milton, - - -	Boston, May 15th	37 0	36 30	35 0	32 0	27 30	26 0	28 15	37	40
Lamartine, - -	N. York, June 10th	34 0	32 0	31 30	31 0	29 0	26 0	28 49	33	37
Z. D. - - - -	N. York, " 15th	‡39 0	37 0	35 0	34 0	33 0	24 30	28 50	35	37
Sarah H. Snow, -	Boston, " 23d	‡39 0	36 0	33 0	31 0	29 0	23 0	27 00	38	42
Talbot, - - -	N. York, " 27th	35 30	34 0	30 0	28 30	25 0	19 0	25 00	41	43
Thactus, - - -	N. York, June 29th	34 0	32 0	30 0	27 0	25 0	24 30	30 48	43	46
Plato, - - - -	Boston, July 1st	‡40 0	36 0	34 0	29 30	26 0	20 0	27 0	35	37
Wessacumcon, -	Boston, " 7th	‡41 0	39 0	35 0	30 0	25 0	23 0	29 0	50	54
Eagle, - - - -	New York, " 11th	‡49 0	47 30	46 30	44 30	44 0	†23 0	28 0	33	35
Cohansey, - -	New York, " 20th	‡46 0	43 0	40 0	37 0	34 0	†24 30	28 56	35	38
John Wade, - -	Boston, Sept. 5th	‡45 0	42 0	41 0	39 0	32 0	24 0	29 0	34	37
Lewis - - - -	Salem, Oct. 10th	37 0	33 0	30 0	27 0	26 0	25 0	28 0	34	37
Sartelle - - -	N. York, Oct. 23d	39 0	28 0	29 0	28 0	27 0	24 0	26 55	43	46
Loo Choo - - -	Boston, Nov. 2d	35 30	35 0	35 0	33 0	30 0	27 0	30 0	34	37
Juniata - - -	Baltimore, " 23d	30 0	27 0	27 30	27 30	27 30	27 30	28 0	28	30
Europe - - -	N. York, " 25th	37 0	30 0	28 0	26 0	25 30	25 30	26 22	32	35

It appears by these tables that the average passages to the equator, by the new route, from June to December inclusive, have been greatly reduced; that the average passage to the Line for any month, is not over 34 days; and that the shortest average for any month is 26 days.

Moreover, by comparing the new route tracks with the "middle route," as the tracks made by those navigators who attempt to "split the difference" between the old route and the new are called, we shall see how much they lose: they lose on the average, during a portion of the year, a week or more, and several days at any season.

It will not escape the notice of men who study these tables as carefully as they ought to be studied, that from May to November, inclusive, vessels that go the new route cross the parallel of 5° N., farther to the Eastward on the average, than they do the Equator. The cause of this is obvious: it is owing to the Monsoons of the "Doldrums." Hence we deduce a rule which will apply to all months, and it is this: When

* Should not have cared to make any more eastings than she could help, after this.

† Entered the "Doldrums" too far to the eastward.

‡ Started on the new route, but abandoned it.

you cross the parallel of 10° N. in 30°, or 31°, or 32° W., and can make a South course good, don't care to go any farther East. Of course, if you meet these southwest monsoons, as in the summer and fall you will sometimes do, even as far West as 32°, you will in that case be compelled to obey the winds, and make easting; but when you are East of 30° always prefer the tack that will give you most southing, because it will put you across the "doldrums" soonest; and if it bring you across no farther West than 31°, or even 32°, you may consider yourself in a good position, and clear of a region of light airs and baffling winds.

The average passage for the year by the "middle" route is 35 days; by the old it is 41; by the new 29. Thus it will be perceived that those who attempt to "split the difference" between the old route and the new, split it as completely with regard to time as they do with regard to distance.

It is hoped that this exhibit, including everything that I have received with regard to the Rio passage, since the publication of the last edition of these Sailing Directions, will serve to convince the skeptical that these charts are what they purport to be: i. e. the result of the experience of all the navigators, whose logs I could lay hand on for comparison, and that they are not based on *any* theory of *any* body.

Some vessels are put down on the middle route, which did not intend to take it. They were forced farther to the eastward before crossing the horse latitudes, than they intended to go. They did the best they could; and might have been classed under the new route; for when winds are ahead, the "new route" expects the navigator to do the best he can, for head winds will now and then drive him broad off the track.

If the few passages that come under this category had been so classed, the contrast in favor of the new route would have been still more striking than it is.

The shortest passages to the Line made within the time included in the tables, are, for the several months, as follows: by the "Sea Serpent" in March, 18 days; the "Flying Fish" in November, and the "Samuel Russell" in December, 19 days each; the "Maria" in February, and the "White Squall" in April, 21 days each; the "Flying Cloud" in June, in 22 days; the "Black Squall" in January, 24 days; the "Isabelita Hyne" and "Staffordshire" in May, the "Raven" and "Sovereign of the Seas" in August, and the "Comet" in October, each in 25 days.

Of the Passage around Cape Horn.

The force engaged upon the Charts at the Observatory has been so much interrupted, that I have not yet had time to discuss the Cape Horn route, according to the method used for discussing the best routes to the Line. Pilot Charts from 50°S. to 62°S., and from 55° W. to 91° W., on a scale of 1° Lat. 2° Long. have been published to aid navigators in their Cape Horn perplexities. A careful study of these Charts is necessary to a proper knowledge of this passage. The first injunction therefore, in a set of Sailing Directions for doubling Cape Horn is to consult, whenever the winds are adverse, the Cape Horn Pilot Charts.

Vessels bound round the Cape, should first, however, after leaving Cape St. Roque, aim, if the winds

will let them, to cross 25° South in about 35° W. At any rate, as far off from the land as, with a good clean rapfull, they can without going to the East of 33° or 34°.

After passing the parallel of Cape Frio, they should make the best of their way South, aiming always to pass *inside* of the Falkland Islands, and if wind and daylight serve, through the straits of La Maire.

The reason for this recommendation is this: After crossing the parallel of Tierra del Fuego, the difficulty is to get to the westward. Therefore it is better to make westing on this side, when it is practicable and where the weather is mild, than to put it off for the stormy latitudes, where it is more difficult.

Captain Smyley, who has been engaged for many years in the seal fishery of the South Seas, has furnished me with some remarks and sailing directions in relation to this part of the ocean, so also have Capt. Bryson and others; navigators may find these remarks useful; I therefore copy them.

From Captain Leslie Bryson of the Brig "Daniel" to Lieutenant M. F. Maury.

"In compliance with your published request, I avail myself of the earliest opportunity to forward to you an abstract journal of the "Brig Daniel," formerly the United States Bomb brig Hecla, kept by me on her voyage from New York to California, which is but a poor tribute for the manifest advantage and valuable knowledge, imparted by the aid of your truly useful and ingenious system, which I regard as one of the most valuable inventions of the age, and doubtless will yet lead to results, far beyond its present apparent purpose, to speed the voyage.

Noticing your intimation to West India traders for further data, to complete your Wind and Current Chart of the "West Indies," I have written a friend to send you my private journals, embracing a period of about six years, commencing May, 1838. These journals were kept for the purpose of facilitating a practical knowledge of winds, &c., for which I thirsted, without the means of obtaining any reliable information, except the divers accounts furnished by casual observers, which like the various sailing directions for Cape Horn, serve rather to distract the mind than to assist the judgment. I was in the constant habit for several years of referring to these journals with the sole view of obtaining the very information that your charts so plainly and beautifully illustrate. My personal observation, therefore, confirms me in the truth of your system. Having been kept solely for private use, you will find many remarks in those journals quite irrelevant to your purpose, nevertheless in your hands, I trust they will be acceptable. The temperature of the air and water were only noted in approaching and departing from our coast. At different times I have found a cold place in the centre of the Gulf bearing about S. E. by S. from "Montauk." I do not know whether the remark is noted in my journals, but I am certain of the fact.

The currents may not always have been regularly noted, except when unusually strong. In reference to my present passage, I would state that I followed your directions, as near as winds would permit. Although the vessel was deep, and sailed heavy, I have reason to think our passage was thus materially shortened.

About the parallel of 45° S. a marked change in the weather occurred, followed by a constant succession

of gales. The temperature of the sea had also suddenly fallen some 6° below the temperature of the air, is indicated by the thermometer attached to the barometer in the cabin. The difference of temperature between the air and the water continued with little variation, until we passed the Cape, except a part of the 14th, 15th, and 16th of February, when we stood far enough eastward to bring Faulkland Islands in a line with Cape Horn. At those times the temperature of the sea rose to about the same range as the air; from that circumstance, in connection with the N. E. current, I was strongly impressed with the idea that a steady cold stream set to the northward and eastward like the Gulf Stream on our coast, the elements being only reversed, which would account for the continual storms that seem to prevail in that region.

The current continued more or less strong in proportion to the strength and duration of the gales; but varying more easterly as we drew up with the "Horn," until we were fairly past it, and nearly up with the latitude of "Cape Pilar," amounting to no less than 650 miles! Considering this great drawback in connection with the almost constant adverse gales, many of which were so heavy that no ship could bear canvass, it seems highly important to ascertain the most desirable route, if possible, to avoid such serious dangers and delays. It was my intention to have doubled the Cape close, and keep near the land all the way round. But after making "Diegos," the violence of the gale seemed to render it a matter of prudence to keep an offing, then there was difficulty in making northing without also making much easting. When we finally succeeded in again attaining the latitude of the "Horn," the gales were not so furious but that we could carry close-reef topsails. The second day after our departure from Diegos, the current had set us so far to the E., I could not believe my chronometer, and supposed I might have inadvertently stopped her 10′, which I deducted in order to make our position where I wished it to be. I continued to work time every day when an opportunity offered, and seldom missed a day, considering the dreadful weather. Arriving at "Juan Fernandez," I found my chronometer perfectly correct, and have since corrected the longitude for the 10′ subtracted. I mention the above to show that you may rely upon my observations upon the currents, &c., with more accuracy than is usually bestowed by merchantmen. Adverting to the winds of "Cape Horn," I would state that I projected wind circles like yours on the margin of your Chart of "Tracks" for the Cape. The result led me to expect S. W. and N. W. as the prevailing winds for the months of February and March; but it was our hard fate to find them from W. S. W. to W. N. W. per compass. I contemplate making the voyage round via China. If so, shall continue the abstract with such remarks on the movement of the elements and natural phenomena as may come within the range of my observation."

From Captain Smyley to the same.

"In looking over your valuable Sailing Directions and Charts, which I consider the best guides ever given to the navigator in pointing out the means of shortening the passage to his port, as well as shunning the calms, which has caused so much detention in vessels crossing the Line, and also of the advantages taken by standing more to the westward, and passing nearer Cape St. Roque. I have tried both routes to my own

satisfaction, and am well satisfied on my own part that the western route is far the best, and have for several years recommended it to be taken, and I am happy to say I have been since told by many that it is the most preferable.

I sailed from Newport, R. I., July 3d, 1836, in the schooner "Sailor's Return"—myself master—bound to the Falkland Islands and South Shetlands. The schooner "Geneva," Captain A. Padack, my consort, sailed the same day, and kept company with me until we arrived in the latitude of 4° N. and 25° West. The winds were light and baffling from S. W. to S. S. W for one or two days. I stood to the westward, but *he* began to worry for fear of falling to leeward. I left him, giving him instructions to proceed with all possible dispatch, and meet me at the Falkland Islands: we were then in 4° 16′ North, and 26° West, wind S. S. W. The "Geneva" stood on her eastern tack, *I* to the westward, and arrived at the Falkland Islands twenty-one days before her.

On examining our journal, I found I gained thirteen days of the time between 4° North and 8° South, by nothing but his being afraid of falling to leeward; whilst I could lay the land along, he was continually tacking about; and as for a current, I tried several times, and found but very little setting N. W. There was the schooner "Ann Howard," of New London, had the same passage as the "Geneva," and took the same route; she had eighty-one days to the coast of Patagonia, and eighty-three to Port Desire, latitude 47° 45′ S. longitude 65° 54′ W. The A. H. sailed within one day of the Geneva, andarrived within two days of her, giving me twenty days ahead of one, and twenty-three ahead of the other.

"Sailor's Return," a second voyage, sailed 22d August, 1838; and in thirty days was cast away at Cape St. Roque, standing along shore on the off-shore tack, having made the land that morning. I was bound in to Rio Grande North to repair my sheathing which had started off the bottom. I crossed the line in 35° 40′, I found no trouble in getting up the coast, until I struck on the reef at Cape St. Roque.

I found the tides tolerably regular at the Cape during the few days I was on shore, and the pilots say the currents are trifling on the coast from St. Roque to St. Augustine, when you are in more than forty fathoms water, and I believe it is true, for I have tried it since, and found very little, if any.

Schooner "Benjamin De Wolf," W. H. Smyley, master, sailed from Newport, R. I., for the Falkland Islands, 2d of April, 1839. Having a sharp vessel, and every confidence in my own mind of the western route, I determined to steer my course as if bound to Fernando do Noronha, and to pay no attention either to winds, weather or currents, no more than if such was not to be found on the route. I found no calms, and but little rain. I passed inside of Fernando do Noronha, distant twelve or fifteen miles, and passed Olinda in twenty-one days and eight hours, and from St. Augustine to Port Egmont, I had but twenty days—making but forty-one days and eight hours passage to the Falklands.

Schooner "Benjamin DeWolf," second voyage, W. H. Smyley, master, sailed from Newport, R. I., 28th May, 1840, for Patagonia, and arrived at Rio Negro, latitude 41° 4′ S., longitude 62° 49′ W., in forty-one days, passing about fifty-five miles east of Fernando do Noronha, and crossing the Line in 36° 15′. I found the wind from N. W to S. W., more than from any other quarter, from the line to St. Roque. The current

I had no opportunity to try, but am sure it is more governed by the wind than anything else, but far less than people in general suppose.

Schooner "Ohio," W. H. Smyley, master, from Newport, R. I., to Rio Negro, Patagonia, sailed September 29th, 1842, in company with the "Sarah Ann," Gough, master—consort to the "Ohio"—kept company until in 16° North and 40° West. Captain Gough, as well as Padack, wished to cross the line well to eastward, and although they were both under my instructions and control, I permitted them to have their choiçe. After leaving Captain Gough, I steered for Fernando do Noronha as before, but kept on until I found myself in sight of Cape St. Roque, passing inside of the Rocasses, ten miles, and by making a short tack off Mananguapa, passed Pernambuco, distant about eight miles, being then out thirty days. I stopped three days at San Francisco, and three at Isapacaray, making my passage to Rio Negro in sixty days including stoppages.

"The Sarah Ann" made no stoppages and came in ten days after me, making my passage sixteen days shorter than hers, exclusive of being embayed two days. I found by overhauling their Journal and Log that they kept well to the eastward in that old *beaten turnpike* of former navigators, crossing in from 24° to 25° W., and that most of my gaining was from about 4° N. to 8° S., which convinced me of the advantages of the western route.

Schooner "Ohio," first voyage, W. H. Smyley, master, sailed from Newport, R. I., July 14th, 1841—making my passage in fifty days, including two days stoppage at the Brazils for recruits. I passed so close to the Rocasses, and not being able to get good observations, owing to the weather, that I am not sure which side I went on.

On my arrival in the Brazils, I tried my chronometer by artificial horizon, and found it correct. It was in the day time, and I kept a good look out for them, until I was sure I was to the South of them. This voyage I had no consort; I found but little current setting W. N. W., this was near the Rocasses, perhaps one degree, or a little more, North of them.

There is another thing still more remarkable: although you have more wind near the land, yet the sea is much smoother than it is further to the eastward. The natives who fish on the catamarans along the coast, have repeatedly told me that the current was but trifling: you will often see two of these catamarans at anchor, tailing in different directions, but generally with the wind. If the current about Cape St. Roque was as strong as persons in general imagine it to be, the clump built coasters would not be able to make head way, and beat from ——— up to Pernambuco at all seasons of the year as they do.

Schooner "Catharine," of Newport, W. H. Smyley, master, bound to Patagonia. I left Newport, September 10th, 1845, and stood to sea, with the intention of taking my old route, that is, to steer for Fernando do Noronha, or nearly that course, so as to pass East of the Bermudas, but the wind prevailing more to the South, gave me a chance to keep well to the eastward; I stood boldly on; but had the wind light, with heavy rain squalls, and much thunder and lighting; crossed the line in 23° 32′ making little head way, having light airs and a very irregular sea. Although I found so much rain and light winds, the sea did not seem to fall in the least, causing the vessel to thresh heavily, and be very uneasy. I spoke a brig which had been eight days longer than myself in these rainy regions, and off Pernambuco I spoke one which had

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been ten days less, being to the westward of me. I was forty-five days to Olinda, and twenty days from there to Rio Negro, Patagonia, and I fully believe, if I had taken the western route, I would have made a very short passage, as the vessel sailed very fast, was in good trim, and well manned.

Pilot boat "John E. Davidson," W. H. Smyley, master, from New York, towards Coast of Patagonia, sailed July 5th, 1849.

July 6th	- -	The Hook and Light-house in sight.						
7th	- -	Wind W. S. W.	Latitude	38°	43′ N.	Longitude none.		True Longitude.
8th	- -	Wind light S. E.	"	38	31	"	none.	
9th	- -	" S. S. E. and S. E.	"	38	14	"	none.	
10th	- -	" S. S. E. and calm	"	38	03	"	none.	
11th	- -	" Calm.	"	38	00	"	none.	
12th	- -	" North	"	35	07	"	66° 53′	59° 07′
13th	- -	" S. W. and calm	"	35	04	"	65 02	
14th	- -	" South	"	34	48	"	63 32	
15th	- -	" South	"	34	29	"	61 23	47 40
16th	- -	" Variable	"	33	38	"	60 52*	

Homeward passages in the above mentioned vessels,	Days.	Hours.
"Sailor's Return" from Rio Grande North to Newport - - - - - -	27	4
"Benjamin DeWolf," first voyage, arrived from Morea Mernanguapa - - -	26	
" " second voyage, arrived in March from Morea Mernanguapa -	30	
"Ohio" from Rio de Janeiro to New York - - - - - - - -	34	
"John E. Davidson," Rio Negro to New York - - - - - - -	39	16

In these five passages, after passing Cape St. Roque, I have kept "good full" and always found as I neared the West India Islands that the wind hauled favorably, and the weather became less squally.

Mernanguapa is a small port near Parahiba—See Chart.

There are few portions of the continent of America less known than from the Rio de la Plata to Cape Horn, and none of more importance. The whole of that portion of country, except part of Belgranna and

* Note.—The above is taken from the Log-book of the mate, the winds and latitudes are put down correctly, but the longitude is 13° 15′ out of the way. I merely put down this to show you how erroneous some persons will be. I gave him his longitude on the 16th, when I spoke a vessel whose longitude agreed with mine within four miles, but in crossing the Line, he was almost as *far out* again. I crossed the Line in 34° 15′ on the 5th of August, and on the 7th passed ten miles west of Fernando do Noronha, the weather clear, the Island plainly in sight. On the 9th passed Pernambuco, I found no trouble in getting to the southward. It was my intention to have stopped at Pernambuco, for the purpose of landing some of my crew, who had mutinied on the passage, nearly killing my mate, and shooting me with a pistol. Their attempt to take the vessel, left me without a sufficient number of men to work her, which caused my passage to be much longer than it otherwise would have been. I kept but little reckoning afterwards, and that mostly in my head, for fear of another mutiny, for the crew shipped in New York for the purpose of taking the vessel, and nearly succeeded in doing so. The weather being squally off Pernambuco, I kept on for St. Catharine's and arrived there on the 22d of August, on the 23d or 24th gave my men up to the U. S. Consul, on the 7th September, got under way from St. Catharine's, and on the 16th anchored on the bar off Rio Negro, Patagonia.

Giving me 30 days to the Line.
47 days to St. Catharine's.
56 days to Rio Negro.

Rio Negro, being inhabited only by Indians. It has been the custom of vessels bound to the Pacific, after passing the La Plata to go to the eastward of the Falkland Islands; some wishing to avoid running by La Agle shoal, others fearing to get *jammed* on the coast of Patagonia. This should no longer be an excuse, for the first does not exist, and of the latter there is no danger. I have cruised for the above mentioned shoal several times, taking a good departure from the Jasans and from New Island iu the Falklands, and crossed to Cape Virginis and back in the long summer days, seeing no signs of it. In 1842, I left East Harbor, Staten Land, with my consort in company, and steered for the shoal, keeping about eight miles apart, the weather was clear. I kept men at the mast-heads, and saw nothing of it. My observations were to be relied upon; for I had on board three chronometers, which had been well proved at Cape St. John. I kept on for Rio Negro, and on my arrival, again tried my chronometers, and found them correct. I am well aware that no such shoal exists. I have since then tried to find it with the schooner, but without success. The Beagle and Adventure, and Captain Sullivan of the Navy, have also hunted for this shoal without finding it.

As for a vessel getting blown on shore on the Coast of Patagonia by N. E. gales, it is out of the question. I have spent twenty-two years of my life mostly from South Shetlands to the river La Plata, and once I remained six years without coming north of 41° S., and I cannot say that I ever knew during that time the wind to blow heavily directly on shore for twelve hours. My voyages being principally made for sealing or whaling, caused me to keep close into the coast, whereby I had the best opportunities for observing the weather, currents, tides, &c.; in fact my voyages depended partly on these, and it stood me in hand to make myself acquainted with them.

I have always found that the sooner I got to the westward, after crossing the Line, the better. I always try to make the Peninsula of St. Joseph's, between New Bay and Port Valdez. The land is high, steep, clay cliffs, flat on top. Then I endeavor to keep near enough to see the land until I get well to the South, so as to pass close by Staten Land; by doing this, I have smooth water, winds from N. W. to W. N. W., and pleasant weather; while another vessel will have the wind from W. N. W., and S. W. off the Falkland Islands, and on the South side of the Islands the wind will be from S. W. to S. This I have proved by having left men on the Jasans and the Bushenes, (these being the extremes of the Islands, both sealing grounds,) and requiring them to keep a journal of wind and weather. I found the wind to prevail much more from the S. W. and S. S. W., about one-third or one-half way between Cape Horn and ————, and beyond that distance it drew more to the westward, and even to the northward of West. It was a common thing while at anchor under Diego Ramirez, or sealing on shore, to see a vessel pass in-shore of the Island heading up two points higher than another vessel off shore of them; and I have often started to go in to anchor, heading well up for the place I wanted to come to at, and found as I drew in-shore, the wind gradually headed me off. When bound to Shetlands from the Cape, or from Staten Land (Shetland is our rendezvous on account of getting wood there to last until our return,) we always find after passing the latitude 60° S., the weather much milder, fewer blows, but more fog. The currents as well as the winds are generally the reverse of what they are off Cape Horn. The prevailing wind at Shetland is N. E., while in the track generally taken by vessels,

it is S. W. The current is similar, for it seems more like a Gulf stream than a common current following the direction of the wind.

No navigator should be afraid to approach the coast. Soundings are found far out, the water is much discolored, as the land is neared; and we have another sign which seldom fails in the day-time, *i e.* the small gulls which will always be found in forty or fifty miles of the coast, making their presence known by the noise they make as soon as a vessel is perceived. This seldom fails to be the case.

The navigator should not be backward in tacking as soon as he finds himself getting off shore, for the wind will often lead him along for two or three points, and then favor him for a short distance again, by which means vessels often get so far to the eastward as to lose much time. I would always recommend a ship to tack in shore, even if she could make no better than a W. N. W. course, in preference to going to the eastward; for by keeping well in, she will have smooth water, clear weather, and wind more off shore. While on the other hand, when she nears the Falklands, she would begin to have fogs, rain, and sleet, and South of the islands the rain becomes hail-stones and snow. A short distance in these latitudes makes a great difference in wind, weather, and tides.

For comparison, take Santa Cruz harbor, on the coast of Patagonia, latitude 50° 8′ S., longitude 68° 21′ W., tide in spring forty-eight feet. The Jasan Island, belonging to the Falklands, latitude 51° S., longitude 61° 20′ W., tide but six feet: here is a great difference in 7° of longitude, about 260 true miles. This will show the extraordinary difference made in tides by a short distance, and the weather in proportion to the tides: on the one it is seldom known to rain, at the other it rains half the time. At the Straits of Magellan in a similar way: it seldom rains at the eastern entrance, and at the western it seldom stops; but this is owing more to the mountains leading from Cape Forward along the straits and from thence to Cape Tres Montes or Chile.

Hereabouts we have but little thunder and lightning, but one may be on a hill above the rain, while those below have a heavy storm; I have seen this occur on Staten Land, also on Juan Fernandez and Massafuera.

Temperature in high southern latitudes differs greatly from temperature in northern; in southern latitudes there seems to be no extremes of heat and cold as at the North.

Newport, for instance, latitude 41° N., Long. 71° W., and Rio Negro, Lat. 41° S., Long. 63° W., as a comparison.

In the former the cattle have to be salted and fed during the winter, not being able to get along in the fields on account of snow and ice.

In the latter, the cattle feed in the fields all the winter, there being plenty of vegetation, and no use for hay.

On the Falkland Islands, thousands of bullocks, sheep and horses are running wild in the country, getting a living all through the winter. This could not be in similar northern latitudes.

On the other hand in the latitude of 50° to 51° N., rye, barley, wheat, &c., can be raised during the summer, but in South latitude there is not sufficient heat in the summer to bring such things to maturity, for even in the depth of summer, you would be liable to snow squalls. After passing the latitude of 40° S., the summer is not so warm, and the winter not so cold as in northern latitudes.

You can see by reference to the book published by Commodore Wilkes, that the extreme cold had but in one instance been as low as 5° below zero. This I ascertained from a self-regulating thermometer, in latitude 63°, and gave him. Since that time, it has never been so low. The heat I could not ascertain, as the index in the tube shifted, while I was lifting the instrument up. I tried to procure one sometime ago in New York, but could not find one. I intended to have placed it in a much higher latitude, as very little is known about either extreme of temperature on the land. For instance, many suppose that Palmer's Land is a continent, and connects with the land laid down by Wilkes; however, this is not the case, for I have sailed round Palmer's Land and far South of it. * * * * *

Owing partly to negligence and partly to disasters, I have no logs or books which will be of use to you. But I will try this cruise to send you some; and if you know of anything particular from the La Plata to as far as 70° S., I may be able to give you some information, for to that place I have given most of my attention, as my business has been there during the greater part of the time.

While I was at this book it occurred to me to send some leaves out of a scratch book which might be of some use in showing tides, harbors, &c., so I tore them out and send them to you. I have done this very hastily and in a most bungling manner, but I did not know that I would have to go away so soon and would not be able to finish. So I have driven ahead and done what I could.

If you choose I will distribute those charts to men who I know will take care to return the journal to you, on their return home, for I consider them to be a benefit to all seafaring men.

I will write you again before I leave."

The opinions expressed by these two navigators—Captains Bryson and Smyley—as to the passage to the Line, and the Cape Horn Route, are fully confirmed by the Pilot Charts; and though sometimes a vessel by going to the East of the Falkland Islands, may have good luck, fine weather, good winds, and a short passage, it should be considered as the exception, but by no means as the rule. The combined experience of all the Cape Horn navigators whose journals have been consulted during the progress of my investigations, is against the eastern, and in favor of the western, or in-shore passage, as a general rule.

I find in the Abstract log of the Ship "Defiance" (Robt. McCerran) the following excellent remarks, concerning this passage:

"September 26th, 1852. At 4.30 A. M. hove to for daylight. At 8.30 A. M. entered the straits of "Le Maire;" wind at N. N. E. At 10 A. M. Cape St. Diego bore West per compass, and Staten Land S. E., entirely covered with snow. At 11.30 clear of the strait. I am surprised that this strait is not passed by all ships in preference to passing East of Staten Land; "Le Maire" being free from shoals, and 14 miles wide. An experience of 21 years command in the Liverpool trade convinces me that the passage between Tuskar and the Smalls are trebly dangerous, and I can see no difficulty in this passage that is not much greater in the navigation of the Irish Channel, either North or South about.

I should certainly beat through in preference to going within 3 miles of the land. I have no doubt that an eddy from eastward—I found a current close in shore setting S. W., and by keeping the current from the

S. W.—must prevail under any circumstances. "Good Success Bay" affords easy access and good anchorage. It may be said that heavy gales ahead and thick weather, make the passage dangerous. In answer I say, that it cannot blow harder than it does in the Irish Channel, and the fog cannot be so dense as it is on the coast of Ireland, as the water is deeper and the air colder in Le Maire. Besides the number of vessels on the Irish coast increase the danger by the chance of collision, and there is no other passage to approach, Sir."

ABSTRACT LOG OF THE SHIP "DEFIANCE," ROBERT McCERRAN, COMMANDER, BOUND FROM NEW YORK TO SAN FRANCISCO.

Date.	Latitude at Noon.	Long. at Noon.	Currents. (Knots per hour.)	Barometer.	Ther. 9 A.M.		Winds.			Dis-t'nce run.	Remarks.
					Air	Water: Surface.	First part.	Middle part.	Latter part.		
	N.	W.	m.		°	°				m.	
Aug. 2	4°03′	33°09′	35 S.W. ½ S.	30.	79	80	S.S.E.	E.S.E.	S.E.	123	Light breezes and baffling. Stood 1h. N. E. At 11 A. M. passed between Fernando de Noronha and the Rocasses. By good observations passed within 10 miles of the Rocasses, but could not see them from the masthead. Think they are west of position on *Imray's* chart.
3	6 14	34 39	31 S.W. ½ S.	30.	78	80	S.S.E.	S.E.	S. by E.	175	Made the land 60 miles south of St.Roque; too far E., 15 miles. I am satisfied that the sailing directions of Lt. Maury have thus far shortened my passage, and this abstract proves that; though I was forced as far W. as 40° 30′ when in 11° 30′ N., yet by watching chances, I was enabled to cross the line in 31° 55′ W. without making northing over 30 miles; and though under anxiety on account of the bugbear of westerly current, I did not find it but *one* day, and generally on the current track I found a S. E. set.
	S.										
Sept 29	56 14	71 01		29.8	41	44	W. by S.	W.S.W.	W.	122	Fresh gales and squally, with heavy sea.
30	56 11	71 26		29.7	42	44	W. by N.	W.	W. by S.	138	Fresh gales and head sea.
Oct. 1	56 51	72 58		29.2	40	42	W.	W.S.W.	W.N.W.	70	Strong gales and heavy sea.
2	56 35	73 15		29.	39	42	"	"	S.W.	47	Strong gales, rain, hail and snow
3	56 34	72 42		28.8	39	42	W.S.W.	W.	W.S.W.	35	" " " " "
4	56 39	72 48		28.6	40	41	S.W.	"	S.W.	105	Strong gales and heavy sea.
5	56 19	73 01		29.	41	41	W.	W.S.W.	W. by S.	95	Fresh gales. Sea subsiding.
6	56 51	73 25		29.7	43	42	"	W. by S.	W.	118	" " Heavy sea.
7	56 34	76 29		29.5	41	42	. by N.	W.N.W.	N.W. by W	111	" " Long rolling swell
8	57 05	78 17		29.6	42	42	N.W.	N.W.	N.W.	71	" " Rain and hail.
											During the above 10 days from close reefs to top-gallant sails—tacking ship as occasion required, yet not so bad as a winter passage from Liverpool to New York.

Capt. Young of the Ship "Venice," of Philadelphia, in his admirably kept abstract, makes also some judicious remarks upon the subject of the Cape Horn passage.

Capt. Young's log is deserving of special notice also, for the very excellent use he makes of the barometer.

His remark that the indications of the barometer will show when the navigator enters, and when he quits the trades, is perfectly philosophical.

In the calms, both of Cancer and Capricorn, the barometer ought to stand higher—say one-tenth of an inch, (0.1) on the average—than it does either in the "variables" on the polar side of these belts, or in the "trades" on the equatorial side of them.

In the belt of the equatorial calms, it also ought to stand, on the average, a little lower than it does in the N. E. or S. E. trades on either side of those calms.

The close attention which Capt. Young gives his barometer, will, as a general rule, enable navigators in most cases to tell whether they have crossed the calms or the trade wind belts, or not.

See also the log of the "Great Britain," for Capt. Caldwell's remarks on his barometer during his Cape Horn passage.

ABSTRACT LOG OF SHIP "VENICE," OF PHILADELPHIA, JOHN H. YOUNG, COMMANDER, BOUND FROM NEW YORK TO CALIFORNIA, 1850.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	THER. 9 A.M.		WINDS.			REMARKS.
						Air.	Water.	First Part.	Middle Part.	Latter Part.	
1850. Jan. 28	No obs.	—	—	—	29.6	55°	60°	N. N. W.	E. S. E.	E. S. E.	Discharged Pilot at 3.30 p. m. At 6 p. m., Neversink Lights bore W. I have determined, during the coming voyage, to keep the "Abstract Log" of Lt. Maury, and thereby add my mite to the cause of science, in the hope that the day is not far distant when navigation shall be so simplified and reduced to "fixed principles," that all uncertainty may be removed.
29	"	—	—	—	29.4	59	68	S. S. W.	S. W.	W. N. W.	First and middle part variable and baffling—latter, fine breezes. Strong rippling which I judge to be the counter current of the Stream.
30	37°50′ N.	68°12′ W.	1 ½ E. by N.	—	29.	62	73	W. N. W.	N. N. W.	N. N. W.	At 4 p. m., the water rose to 70°, and to 73° at 5—Water remarkably smooth, with a fine breeze blowing—ship going fast.
31	36 55	63 32	19, E, & 5 W. S. W.	—	29.4	68	72	N. N. W.	N. N. W.	N. N. W.	Fine breezes and water smooth—temp. 73°—during the night fell to 72°; at 9.30, water 71°. Have paid particular attention to the Log since entering the Stream, and find that we began to leave the stream about 9 a. m.
Feb. 1	35 21	60 27	15, S. W.	—	29.6	64	71	N.	N.	N.	Strong breezes with considerable sea—Barometer rising. I have determined to cross latitude 30° to the west of longitude 50°, if permitted by the wind.
Feb. 2	34 16	58 12	8, S. W.	—	29.8	66	71	N.	N. N. W.	W. N. W.	Fresh breezes & pleasant weather.
3	33 32	56 55	6, S. W.	—	29.7	67	71	W.	W. S. W.	S.	Fine clear weather—Barometer high and steady.
4	34 05	54 04	—	—	29.7	69	72	S.	S.	S. S. E.	Fine clear weather, such as is

											rarely met with at this season of the year in the N. Atlantic. I almost regret the wind hanging here, as I desire much keeping to the West, for the purpose of giving the "Theory" of Lt. M. a fair trial, having a "weatherly ship," and no fear of "Cape St. Roque.
Feb. 5	34 42	51 30	—	—	29.6	68	72	S. S. E.	S. S. E.	S. S. E.	Fine clear weather—the horizon astonishingly clear. I scarcely recollect having more delightful weather—steady glass—smooth water—everything indicating midsummer, more than the last 48 hours.
6	34 59	49 01	—	9 40 W.	29.6	68	72	S. S. E.	S.	S.	First part fine—middle, Bar. falling fast—dirty appearances—observed variation at sunset 9.40 W.
7	No obs.	—	—	—	29.	66	72	S. S. W.	W.	N. N. E.	Cloudy dirty weather—*not much wind*—Barometer steadily falling—Ship under short canvass—heavy appearances all round, and every appearance of a heavy gale.
8	"	—	—	—	28.6	64	72	N. N. E.	N. E.	S. W.	Glass still falling—heavy appearances—everything "snug" for a "blow."
9	"	—	—	—	28.4	64	72	S. W.	W.	W. N. W.	During the first and middle part, Bar. fell to 28.2, with very bad looking weather.—At sunrise there was but little wind, but in less than half an hour, it blew furiously at S. W., veering to the West; the sea rose so rapidly I was obliged to "scud;" by 9 A. m., although the wind was blowing very heavy, *the glass began to rise*. Owing to the ship being deep and steering badly, I was induced to try what I had frequently heard of; namely: paying a hawser out astern. I middled and payed out 45 fathoms

ABSTRACT LOG OF THE SHIP "VENICE"—CONTINUED.

Date.	Latitude at noon.	Longitude at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	THER. 9 a.m. Air.	THER. 9 a.m. Water.	WINDS. First Part.	WINDS. Middle Part.	WINDS. Latter Part.	REMARKS.
											of 11 inch hawser on each quarter, and found instant relief; so much so that I shall most assuredly adopt it hereafter in bad steering ships.
Feb. 10	No. obs.				28.6	68°		W. N. W.	W. N. W.	W. N. W.	The gale still continuing but every appearance of abating. I cannot forbear expressing the great benefit resulting from the trial with "halser," feel satisfied I could not have "scudded" without it. I regret being driven to the E.
11	27°06′ N.	38°42′W.	S. E. set in since last ob'n.		29.	70	72°	W.	W. S. W.	S. W.	First part moderating and hauling to westward and southwest—since observation of 6th we have had 40 miles of S. E. set. In all my voyages across the equator, I have never been so far East in this parallel before; for although there can be no doubt that the westwardly route is best, yet I have had a great desire to give it a fair trial by keeping *farther than usual* to the westward.
12	25 34	36 31	W. S. W. $\frac{1}{2}$ k.	11° W.	29.6	70	72	S. W.	S.	S.	Throughout moderate from southern board with a heavy N. W. swell, for which I allow 15 *miles set*, during the 24 hours, everything apparently combines to capsize my calculations. Var. observed 11° 5′ W.
13	25 18	35 42	W. S. W. $\frac{1}{4}$ k.		29.8	72	72	S. S. E.	S. E.	S. E.	During these 24 hours tacked several times to avail of a point or two in the wind. My great object is to make southing when possible.
14	24 34	35 56	None.		29.7	72	72	S. S. E.	S. S. E.	S.	Wind still hanging to the south-

											ward as I have never known before. Of course I fully expected the "*trades*" ere this, which perhaps increases the annoyance, as I shall almost entirely be deprived of availing of the Pilot Chart, which I approve of so much, that a trial thereof is imperative on me.
Feb. 15	23 30	35 12	None.		29.6	73	72	Variable	from South	to West.	Throughout variable from S. to W. I feel buoyed up that I am really to have the "trades" soon—since the 12th a heavy N. W. swell.
16	21 40	34 00	do.	13.20	29.6	73	72	W.	W.	W.	Wind breezing up again from westward.
17	20 26	32 58	do.		29.9	72	72	W. S. W.	W. S. W.	W. S. W.	Wind light and steady from W. S. W., with a tramendous N. W. swell, giving strong assurance that a gale has prevailed in that quarter, which may have interrupted the "trades." I think this the only reasonable way of accounting for their absence—Longitude per Sun and Moon 33° 3′, Chronometer 32° 58′.
18	20 00	31 44	do.		30.1	74	73	S. W.	Calm.	N. N. W.	Light airs from southward—middle, calm—heavy clouds with lightning to the N. W.—the only indication of "trades" is in the rise of the barometer, which I have generally paid some attention to. During 15 voyages across the equator, as master, I have never experienced anything like the present voyage; for at this season of the year we have every reason to expect the favorable winds of the "trades" after passing the parallel of 25°. It would be a matter of much satisfaction to know what influence has thus thwarted them.
19	17 20	32 52	¼ k. W. S. W.		30.1	75	74	N.	N. E.	N. E.	First part light from northward—

ABSTRACT LOG OF THE SHIP "VENICE"—CONTINUED.

Date.	Latitude at noon.	Longitude at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	THER. 9 a. m. Air.	THER. 9 a. m. Water.	WINDS. First Part.	WINDS. Middle Part.	WINDS. Latter Part.	REMARKS.
											middle, inclining to eastward—latter fine breezes and hazy appearances of these winds. The weather is really delightful, and quite a treat after the annoyances of the last ten days. I hardly yet dare to congratulate myself that the long-looked-for trades have come at last, but hope such will prove the case.
Feb. 20	14°32′ N.	32°20′W.	½ k W. S. W.	11°15′	30.2	76	75	N. E.	E. N. E.	E. N. E.	Fine breezes—everything out, skysail, royal-steering sails, &c., going about 6 knots. The atmosphere extremely hazy—the remains of a new swell still perceptible—observation, Sun and Moon 32° 17′, chron. 32° 20′. During these 24 hours have observed *very great rippling* resembling in some instances the "tide rips" of "Nantucket shoals"—tried the temperature frequently without experiencing any change. I had intended to make the remark before, that we have not seen a bird or fish of any kind since crossing the tropic, which must be considered very unusual, particularly with regard to the birds.
21	12 16	12 16	½ knot W.		30.2	76	75	E. N. E.	E.	N. E.	Light winds and every indication of losing the "trades;" the *glass, however, keeps up*. It may not perhaps be amiss to pay some attention throughout this abstract to the barometer with reference to indicating the trade

											winds. The rise and fall thereof I have frequently noticed on entering and leaving the vicinity of trades. During these 24 hours the ripplings have been very strong, without any apparent change in temperature.
Feb. 22	9 49	30 30	1 k. W. N. W.	10	30.2	77	76	N. E.	E. N. E.	E.	Light winds and hazy atmosphere—very frequent ripplings, more apparent from the extreme smoothness of the water—during the night light squalls, unattended with rain. Sun and Moon 20° 31′. Variation observed 10°.
23	7 13	29 45	$1\frac{1}{2}$ k. N. W.		30.1	78	78	E. by N.	E. N. E.	E. by N.	Light breezes and hazy weather, water smooth, rippling very strong, indicating a strong N. W. current. These 24 hours the weather very fine, and, although the barometer has fallen $\frac{1}{10}$, there is no apparent indications of losing our present favorable wind.
24	No obsn.		$1\frac{1}{4}$ k. N. W.		29.9	79	$79\frac{1}{2}$	E. N. E.	N. E.	E. S. E.	First and middle parts fine—midnight, barometer 30.1, at 4 A.M. 29.9—daylight, heavy appearances to S. E.—from daylight to meridian frequent squalls of wind and rain from S. E. Since 19th the barometer has remained up until within two hours of change from N. E. to S. E. I here predict it will remain below 30° until we cross the equator, or get without the influence of the rainy latitude.
25	3 10	28 40	1, N. W.	—	29.9	83	81	E. S. E.	E. S. E.	E. S. E.	Heavy squalls during first part—middle, strong breezes and heavy head sea—latter part squally—During these 24 hours the bar. has fluctuated *a tenth* several times—weather very warm and sultry—the first "Mother Cary's chicken" of the voyage seen to-day. Thus far, the voyage has

ABSTRACT LOG OF THE SHIP "VENICE"—CONTINUED.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	THER. 9. a. m.		WINDS.			REMARKS.
						Air.	Water.	First part.	Middle part.	Latter part.	
											been extremely barren of incident, not having seen any vessels for 20 days, and scarcely a bird or fish of any kind.
Feb. 26	no obs'	—	¾, N. W.	—	29.9	82°	82°	E. S. E.	S.E.to SSE.	S.E.to S by E	Throughout, heavy squalls rising at South; working round to S. E., with frequent heavy rain; weather very murky and close, at times quite oppressive.
27	2°24′ N.	28°57′ W.	½, W. N. W.	—	29.8	82	82	—	Calm.	—	Throughout, calm with much rain; a confused sea from S. S. E.
28	no obs.	—	½, W.	—	29.8	82	82	E. S. E.	Calm.	—	Throughout, light airs and calm—heavy looking squalls, but unattended with wind—considerable rain at times.
Mar. 1	0 29	29 55	¾, W.	—	29.8	84	82	E. S. E.	E. S. E.	S. E.	First and middle part heavy squalls of rain—Bar. fell to 29.7 at 4 a m., up again to 29.9—Heavy head sea from S. by E.
2	1 27 S.	30 49	1, W.	—	29.7	82	82	S. E.	S. E.	S. S. E.	Throughout, fresh and squally from S. E., with rain—of course ship "close hauled"—heavy head sea from S. by E.
3	2 44	32 04	1, W.	—	29.8	83	82	S. E. by S.	S. S. E.	S. S. E.	Throughout, moderate weather, assuming the settled weather of the "Trades," *only requiring a rise in the Bar. to assure me of that fact*, and I confidently expect the coming 24 hours will so see it.
4	4 17	33 35	1½, W. N. W.	—	29.9	83	82	S. S. E.	S. E.	S. E.	Throughout, mod. fine weather—close hauled by the wind—Mer. *Bar.* 30. *

* "I have no doubt that although for the last few days the wind has been scant, yet 2° or even 3° more to West would have enabled me to cross, say in 31½ or 32° without any fear, as from the experience of many voyages to Pernambuco, I never found any difficulty in *getting past* 'Cape St. Roque,' *even in crossing in* 34° on one occasion. In the event of falling to leeward, I would recommend beating along shore, *inside the reef* always. There are no dangers but visible ones; at least I found such the case, in beating up from the 'Rio Amagosa' a few years back."

Mar. 5	6°8′ S.	34°37′W.	1, W. N. W.	—	30.1	84°	82°	S. E.	S. E. by E.	S. E.	Throughout, mod. fine weather—every appearance of "Trades;" *Bar.* up.; at 8 a. m., made the land.
6	8 08	34 30	1, N. W.	2° W.	30.2	84	82	S. E.	E. by S.	E. S. E.	Throughout, moderate and fine weather; consider myself as fairly within the Trades.

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MEM.—Having, as I consider, got to the westward far enough to make sure of not being "driven back," it may not be out of place to give my humble opinion with regard to the "mooted point" of making the passage around this "bug-aboo" Cape Horn. I most distinctly *disagree* with those who recommend keeping to the eastward of the Falkland Islands; not conceiving the necessity of keeping so far to leeward, rendering the beating against a heavy head sea and strong current necessary. The chances for S. E. winds do *not* in my opinion, make up for the great difference in distance between eastern and western sides of those islands. My opinion is not predicated solely on the beautiful weather I experienced to the westward of those islands; but to the fact, that to the northward and westward of "Staten Land," you are in a measure free from the heavy S. W. swell; which, by reference to *that* part of this *abstract*, it will be observed I had very smooth water, and so continued until I passed Staten Land. In Rio, I had frequent conversations with several whale captains, and their opinions are in conformity with my own. I do not hesitate to say the winter months (May, June and July) are the best for doubling the cape, with more certainty of easterly winds: the only draw-back being the interminable long nights. After all, I feel sure that masters in the European trade, who have during the California fever, made the passage around the cape, will agree with me in saying, doubling Cape Horn is nothing in comparison with making the passage from Liverpool to New York, during our winter months.

June 2	55°09′ S.	77°30′ W.			30.1	36°	41°	S. W.	S. W.	S. W. by S.	Throughout, heavy from S. W. frequent squalls of snow and rain.
3	none.	—	—	—	29.7	34	42	S.W.byW.	W. N. W.	W. N. W.	First part strong—middle more moderate with rain, ends strong with constant rain, under short canvass heading to S. W.
4	none.	—	—	—	29.5	44	42	W. N. W.	W.	W.	Thoughout, heavy gales with constant rain. Bar. rose to 30.2 but fell again towards daylight, weather very disagreeable, *filled all our empty casks with most excellent water;* this may be considered rather singular at this season and in this latitude.
5	52 13	79 15	N. E. since last observation 52 m.	—	29.4	46	43	W.	W.	W.	Throughout, strong from the westward.
6	49 49	80 05	N. E. ¾ knot.	23° 10′	29.7	44	44	W. by N.	S. S. W.	S.	First part, moderate—middle, squally with rain from southward, ends same.
7	46 28	80 47	N. N. E. ½ knot	—	29.7	45	45	S. S. W.	S. W.	S. W.	Throughout, heavy with frequent squalls of wind and rain. The weather feels much colder than any we have yet had.

ABSTRACT LOG OF THE SHIP "VENICE"—CONTINUED.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	Ther. 9 A.M. Air.	Ther. 9 A.M. Water.	Winds. First part.	Winds. Middle part.	Winds. Latter part.	Remarks.
June 8	43°17′ S.	82°11′W.	none.	22 15	30.1	49°	47°	S. W.	S. S. W.	S.	Throughout, strong breezes and frequent heavy rain squalls attended with much wind.
9	42 26	—	—	—	30.3	51	48	S.	Variable.	Variable.	First part light—middle variable and calm.
10	no obs.	—	—	—	30.	49	49	N. W.	N. W.	N. W.	First part light—middle fresh, latter strong and dirty appearances.
11	no obs.	—	—	—	29.8	52	53	N. W.	W. N. W.	W. N. W.	Throughout, dirty, drizzling weather, blowing strong at times.
12	38 53	79 30	—	—	29.9	54	54	W. N. W.	N. W.	N. W.	Throughout, moderate, constant drizzling rain, very unpleasant.
13	no obs.	—	—	—	29.4	54	54	N. W. by N.	N. W. by N.	N. W. by N.	Throughout, moderate, constant drizzling rain, heavy W. N. W. swell.
14	38 03	80 12	—	—	29.4	60	54	N. W.	W. N. W.	N. W.	Throughout, a most shocking bad 24 hours, calm, heavy gales, torrents of rain, lightning, &c. This is the only *really bad* weather I have yet had, and altogether I have seen *very few* more decidedly unpleasant in my life. It is perhaps rendered more so from not expecting anything of the kind, presuming bad times had passed, with passing the cape.
15	no obs.	—	—	—	29.3	62	55	N. W.	N. W.	W. N. W.	First part strong, middle moderate, ends heavy gales and torrents of rain. The Barometer (during last 4 days) has fluctuated repeatedly from 30 to 29, several times in the course of 8 hours, presenting the most remarkable fluctuations I ever witnessed. Since 10th, the weather has been very much like the month of March North 34½° on the coast of U. States.

June 16	36 28	78 38	—	—	29.6	64	55	N. W.	W. N. W.	W.	First and middle very heavy gale, ends, moderating. Barometer down several times to 29.
17	34 28	78 59	—	—	30.	65	56	W.	W. S. W.	S.	Throughout, moderate. At 7 a. m. "Juan Fernandez" in sight bearing North.
18	34 09	80 01	—	—	29.8	65	56	Calm.	N. N. W.	N. W.	First part calm—middle strong—latter blowing hard, much rain. Barometer fluctuating $\frac{5}{10}$ several times during the 24 hours. At 8 a. m. "Massafuera" in sight, West per compass.
19	No obs.	—	—	—	29.6	65	57	N. W.	N. W.	N. W.	Throughout, heavy weather, with almost constant rain. The fluctuations in Barometer still continuing, causing a deal of uneasiness, I have never had anything like it before and this after being an attentive observer of that instrument for more than 22 years.
20	32 10	78 38	—	—	29.6	66	58	N. W.	N. N. W.	W.	Throughout variable, but most remarkable, from calm to lying to, torrents of rain, clear, lightning, heavy sea, smooth as a mill pond; and thus, during the 24 hours every variety of weather under the sun, with the same fluctuations in the Barometer. I am disposed to think *all this* is occasioned by, or prelude to, some great change, perhaps an earthquake, who knows?
21	29 58	79 41	—	—	29.9	63	59	S. W.	S. S. W.	S. S. W.	Throughout squally with rain; wind during squalls hauling far as W. N. W.
22	28 46	79 53	—	—	30.	65	59	S. S. W.	Calm.	N. W.	First part squally—middle calm—latter part moderate. By looking back, it will be seen I have been unable to get to the West, being desirous of crossing the equator about 115°, at the suggestions of many experienced "whalemen." My own judgment would have suggested 90°,

ABSTRACT LOG OF THE SHIP "VENICE"—CONTINUED.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation observed.	Bar.	THER. 9 A. M.		WINDS.			REMARKS.
						Air.	Water.	First Part.	Middle Part.	Latter Part.	
											but the above advisers recommend their crossing far west, on account of better winds.
June 23	26°50′ S.	78°45′ W.	—	13 50	29.9	66°	62°	N. W.	N. W.	N. W.	Throughout, light winds and smooth water; wind at times favoring, so as to lay North, but mostly N. N. E., which with the variation, makes easting fast.
*24	25 29	79 40	N.N.E. ½ knot.	—	30.	66	64	W.	W. S. W.	S. W.	Throughout, light winds and drizzling rain most of the time; but wind being so much better than of late, the change is quite acceptable.

* The rest of this excellent log is omitted because it throws no further light upon the subject.—M. F. M.

In consideration of this very strong evidence in favor of the western or new route to the Line, I quote an extract from the Log-book of the Brig "Eolian," C. A. L. Blanchard, Master.

The "Eolian" sailed from New York, May 3d, 1851, with the charts on board. She crossed the equator in 31° W.—June the 9th—passed St. Roque, June 12th, (40 days out) without going to the west of longitude 33°.

The Captain, in compliance with my general request, that every navigator would state in his Abstract whether he had a longer or shorter passage than vessels arriving about the same time without the Charts, says:

"You will see by this Abstract, my passage has been somewhat lengthy, but in comparison with many vessels which have arrived without your Sailing Directions it has been short. One Barque from Boston having a passage of seventy-five days, and two Baltimore vessels (fast sailers) had a passage of sixty-eight and seventy days; also one from the same port of eighty-five days. The above vessels crossed the line far to the eastward."

I have also the abstract of the "N. B. Palmer," (Charles P. Low, master,) that sailed from New York. April 7th, (4 days after the "Eolian,") also with the Charts on board. She too took the new route:—she passed the "Eolian," May 10th, (the third day out.) Both vessels that day crossed the parallel of 37° N.: the "Eolian" in longitude 56°; but the "N. B. Palmer" 8° farther west. This ship crossed the Line in 31° W. —June 2—and the parallel of Rio, June 15th, or two weeks ahead of the "Eolian;" and from 29 to 46 days ahead of the vessels mentioned by Capt. Blanchard which had not the Wind and Current Charts, and which went the old route.

So also with Captain Caldwell, of the "Great Britain." I quote his letter, and extract from his very valuable abstract log, because of the information which they give as to the Cape Horn passage.

Capt. Eben Caldwell to Lieut. M. F. Maury, U. S. N.

San Francisco, *June 14th*, 1852.

"I herewith forward you the abstract Log of ship "Great Britain," of Boston, under my command from New York to this port. The ship is 25 years old and *not a Clipper*. The ship "John Jay" sailed in company, not yet arrived. The last I heard from her she was in at Rio, leaky. I do not know whether she had your charts. The clipper ship "Aramingo" left New York three days after we did, say 12th January, *without* your charts, went nearly to the Western Islands, crossed the Line in about 26° W., went east of Falkland Islands, I believe, and arrived here one day after I did, say 138 days, without stopping. On my chart (Blunt's) I find St. Paul's Island placed in Long. 28° 20′ W., and in some editions of Bowditch the same, while in other editions and in Horsburgh's Directory, 29° 15′ to 29° 22′ W. As this Island is directly in the track of outward bound ships, it is important that *all charts and books* should be correct. I passed close to it having had a good observation in the *morning*. It was cloudy when I passed it about 4 or 5 P. M., but there is no

doubt that it is in about 29° 20′* and *not* 28° 20′. With regard to your charts, allow me to say I think very highly of them. I crossed the equator in about 30° in 26½ days from New York, after losing my tiller and being thereby detained 16 hours with a *strong fair gale*. I passed to the windward of Noronha, cleared St. Roque and St. Augustine, and the first time I tacked ship from New York was south of Rio, which I passed in less than 37 days, with a very deep ship. Passed through the Straits of Le Maire in 60 and Cape Horn in less than 61 days. After that I had miserable chances. Having been nearly 20 years a ship-master, and having, during my passage, given the subject much consideration, I will venture, at the risk of being thought presuming, to state my own views on the passage from Cape Horn to this port. Being up with Cape Horn, I would improve all opportunities of making *westing*, with very little regard to Latitude, except to keep clear of the land, till in Long. of 80° W. then, if wind permitted, edge off very gradually to the N. and shape my course so as to be in the Long. of 110° W., in about 30° S. Lat.; here you may expect to get the S. E. trades; and then make a due North course *till I took the N. E. trades*. My *reasons* are that you would thus make your westing where the degrees are short, and then cross the entire S. E. trades on a course that would let all your canvass draw, instead of running so much before the wind as to becalm your head sails. You would thus take the N. E. trades in about 110° W., which is as far East as is desirable. You will see by the Log that the 'doldrums' did not detain me much on either side."

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* Its position was accurately determined by the officers of the U. S. S. "Marion," in 1849, to be in Long. 29° 18′ W., and it is accurately laid down on the "Wind and Current Charts."—M. F. M.

ABSTRACT LOG OF THE SHIP "GREAT BRITAIN," EBEN CALDWELL, COMMANDER, BOUND FROM NEW YORK TO SAN FRANCISCO, 1852.

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Bar.	Ther. 9 a.m. Air.	Ther. 9 a.m. Water.	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
	S.	W.		Noon.						
Feb. 27	39°27′	57°20′		29.78	58°	60°	N. N. E.	S. S. W.	S. S. E.	Light, variable and foggy—Latter part clear. Water colored.
28	40 37	59 00		29.75	62	58	E. S. E.	N. N. E.	N. by E.	Have been on soundings since the 23d.
29	42 56	62 00		29.40	67	61	N. by E.	North.	North.	Gentle breezes and fine weather, small lightning in the West. Bar. falling gradually. This P. M., discovered that our main yard was rotten in the slings.
Mar. 1	44 00	63 16		29.48	60	60	North.	S. S. W.	S. S. W.	At 10 P. M., wind suddenly changed from N. to S. S. W. Sent down old main yard, and sent up another this day.
2	45 42	63 42		29.45	59	57	N. N. W.	W. S. W.	S. W.	First, gentle, middle strong breezes—Latter part moderate.
3	46 47	65 00		29.33	58	55	S. S. W.	Calm.	N. W.	First part light airs, middle calm—Latter part fine breezes.
4	48 49	63 45		29.50	54	54	N. W.	S. S. W.	S. W.	At 3 P. M., made Cape Blanco. At 5 P. M., wind hauls to S. S. W., very flawy and baffling. Middle part fresh from S. S. W. Latter part moderate at S. W.
5	51 26	65 45		28.91	52	49	N. N. W.	N. N. W.	West.	Fore part, moderate, with a strong sea from the South. Middle part, fresh breezes. Latter part moderate. Ends nearly calm, while the Bar. has been falling all day, and is now lower than it has been before, since we left N. York. At no time this 24 hours have we had more than a royal breeze off the wind.
6	52 45	66 00		28.78	50	49	N. N. W.	S. W.	W. S. W.	Bar. declined till 11 A. M. Since then stationary. At 10 P. M., wind changed to S. W., but very light. My Bar. alarmed me, but died away start calm. At 3 A. M., fresh breezes from W. S. W.—ship under double reefs. In high northern latitudes, with so low a Bar., I should have expected a hard westerly gale. Within the last few days my Bar. has fallen very considerably, without corresponding winds. Does the Bar. range lower here than in northern latitudes?
7	53 37	66 09		29.8	53	49	W. S. W.	S. W.	Calm.	Bar. declined till 8 P. M. to 28.73, mountains of Terra del Fuego in sight. The Bar appears to me to be no guide here for winds or weather. I never knew so low a Bar. in the North without a hard gale.
8	54 16	65 28		29.23	43	49	W. N. W.	S. S. E.	S. S. E.	San Diego bears S. 26° E.—distant 28 miles.

ABSTRACT LOG OF THE SHIP "GREAT BRITAIN"—CONTINUED.

Date.	Latitude, noon.	Longitude, at noon.	Currents, (Knots per hour.)	Bar.	THER. 9. a. m.		WINDS.			REMARKS.
					Air.	Water.	First Part.	Middle Part.	Latter Part.	
	S.	W.		Noon.						
Mar. 9	54°48′	64°50′	Strong E'ly.	28.90	47°	48°	S.E.& calms	S. E.	North.	At 8 a. m., Cape San Diego bears W. N. W., distance 6 miles. Longitude by land 64° 52′ W. Longitude by chronometer 64° 46′ 45″ W. We are now in the Strait of Le Maire, with a strong tide setting to the eastward. At 12 noon clear of Strait of Le Maire.
10	56 13	67 44	1½k. N.E'ly.	28.82	47	47	N. E.	E. N. E.	E. N. E.	Fine weather and gentle breezes all the 24 hours. Royals and top-gallant steering sails on. At 3 a m., barometer 28.76. At a. m., Cape Horn N. W.; distant 14 miles; distance by observation 121 miles; distance by log 160; difference or current, 39 miles.
11	55 36	72 11	1 k. E'ly.	29.28	47	50	E. N. E.	E. N. E.	South.	First and middle part moderate breezes and fine weather. Latter part fresh breezes.
12	55 54	72 54	"	28.80	45	49	S. W.	W.	W. S. W.	Fore part fresh breezes—Middle part fresh gales—Latter part strong gales. Ship under two close-reefed topsails, with a heavy sea from W. by S.—6 a m., barometer 28.75.
13	55 28	72 48	1 k. "	29.	44	48	S. W.	S. W.	S. W.	Fore and middle part strong gales—latter moderate a little, under close reefs.
14	55 34	73 00		29.20	45	47	S. W.	W. by S.	S.W. by W.	Strong gales—Heavy squalls, and high, ugly sea on.
15	56 20	73 00		29.33	47	47	W. S. W.	W. S. W.	W. by S.	Strong close-reef breezes fore and middle—Latter more moderate, but very unsteady. Barometer rose till 8 a m., when it stood 29.50; now falling. I place but little confidence in it here. In northern latitudes I have watched it for nearly twenty years, and have seldom, if ever, known it to deceive me; now it seems almost useless.
16	56 50	74 28		28.83	46	47	N. W.	W. N. W.	W. by S.	Fore part fresh breezes—Middle, strong gales—Latter, fresh gales. At 6 a. m. barometer 28.76.
17	54 49	74 10		29.18	44	46	W. N. W.	West.	S. W.	Strong breezes and squally. At 8 a. m. wind veers to South in a squall.
18	53 20	76 00		29.50			South	S. W.	West.	First part, strong breezes—Middle, moderate—Latter strong.
19	—	—		29.38	48	47	N. W.	S. W.	N. W.	Gales; 4 a. m. bar. 29.90; at 6 a. m Cape Pillar in sight. Ends under close reef topsails and staysails. At 8 p. m. gale abated—Middle quite moderate—Latter, very strong gales, with rain. Barometer

										fell till 7 P. M., when it stood 29.18; then rose rapidly to 29.60 at 6 A. M.
20	53°57′	77°57′		29.12	47°	44°	N.W. by W.	W. by N.	West.	First part, strong gales—Middle, very heavy gales and heavy sea on, shipping much water—Latter part, gale begings to abate. Barometer at 6 A. M. 29.
21	53 31	76 40		28.88	44	45	West.	West.	W. S. W.	Strong gales and very heavy squalls this 24 hours. Bar. at 8 A. M. 28.80. The barometer frequently falls and rises .05 or .10 without any apparent change in the weather. I think here it ceases to be a *safe and sure guide*. Does the volcanic nature of the neighboring land effect it?
22	52 12	77 27		29.57	46	45	S. W.	S. W.	W. S. W.	Very heavy squalls and gales. Bar. rose steadily till 8 A. M. to 29.58—*No guide*. For the last eleven days, we have had almost constant gales with a very heavy sea. In all that time we have made only 269 miles on our way.
23	51 10	77 30		29.60	48	46	W. S. W.	W.	Calm.	First part fresh gales—middle, moderate—latter part calm.
24	51 17	77 35		29.50	49	49	Calm.	Calm.	W. N. W.	First and middle calm—Latter part light airs.
25	50 05	79 26		29.15	48	49	N. W. by N.	W. by N.	W. by S.	First, fresh breezes—middle, moderate—latter, fresh gales with rain.
26	47 29	78 46		29.45	54	52	W. by S.	W. by S.	W. S. W.	First, strong gales—middle, more moderate gales—latter, strong breezes.
27	44 26	80 20		30.03	56	54	S. W.	S. W.	S. S. W.	First and middle part fresh gales—latter part moderate breezes.
28	43 33	80 09		30.	56	55	W. by N.	Calm.	Calm.	
29	42 01	79 42		29.93	55	57	N. W.	N. W.	S. W.	Moderate breezes with light rain.
30	40 00	80 48		30.25	58	58	S. S. W.	S.	S.	On examining our water and provisions, we find that some of our water casks have slued in the heavy weather off Cape Horn, and some of the water leaked out. If the winds are *not very soon* more favorable, I shall have to touch for water; I therefore steer a more easterly course, intending to be governed by circumstances.

Extract from Abstract Log of the ship "Hannibal," Captain Wm. E. Kingsman, bound from Rio de Janeiro to California.

"1851.—Nov. 27th, Lat. 54° 26′ S., Long. 65° 20′ W.; bar. 29.63, temp. air 46°; water 45°; winds—first part N.; middle part N. W.; latter part N. E.; first, strong; middle, light and variable; latter, light. Staten and Terra del Fuego Islands in sight; fine clear weather; steered for Le Maire Straits.

November 25th. Passed through the straits of Le Maire; found the tide or current to change at 3.30 P. M. When just between the two northern points of entrance, a northerly set until 3.30, after which, till about 8, a southerly one. The wind from the northward throughout, and fine clear weather; had one squall from the land while in the Straits.

November 26th, Lat. 56° 10′, Long. 67° 29′; current N. E. 2 miles per hour; bar. 29.79; temp. air 45°; water 45°; wind—1st part N., fresh; 2nd, N. W., moderate and fine weather; 3d, S. W., variable and squally.

November 27th, Lat. 56° 40′, Long. 68° 1′; bar. 29.64; temp. air 42°; water 46°; winds—first part S. W. wind, and latter part W.; fresh gales and squalls throughout; five sail in sight; passed within ten miles of Cape Horn."

Cape Horn navigators should not forget that the prevailing winds encountered in doubling the Cape are westerly winds; that the Andes, which in fact terminate only with the continent, stand up as a barrier to these winds, and consequently these winds come around the Cape in violent sweeps, puffs, and gales, as they do around the bluff point of land in a harbor, or the corner of a building on shore; and that the strength of these sweeping winds is probably felt with more force near the Cape than it is at a considerable distance off, and out of the influence of the land upon the course and velocity of the wind.

Therefore, I would advise navigators in doubling the Cape, first to pass through the straits of Le Maire, if practicable, and if they can accomplish it by daylight—for the currents are strong and conflicting there—to hug the Cape as closely as the winds on one hand, and the rocks on the other, will allow, and so make westing down there when the degrees are short, as fast as without fighting adverse winds and weather they may do, until they cross—if bound to California—the parallel of 50° S. between the meridians of 80° and 90° West.

But, if after getting through the straits, and before doubling the Cape, a westerly gale strike them in the teeth, then instead of stopping there off the pitch of the Cape to fight against it, with the intention of holding their own till the gale abates, or wind slants so as to let them get round, I think the chances would be altogether in their favor, by sticking her away South, under the expectation that they would soon get out of the strength of the winds which, eddy-like, come sweeping around Cape Horn, sometimes at one distance, sometimes at another, according to the direction of the gale. But even in doing this, the navigator who is desirous of making a quick passage, will not fail to take advantage of slants. He will always prefer, until he doubles the Cape, the tack upon which he can make the most westing. Vessels intending to touch at Valparaiso, or any of the "Intermedios," need not care to get so far West while they are South of the parallel of 50°, even when the winds

are fair, as vessels that are bound further North, as to California for example. Let these last make westing whenever they can, without making southing also. They cannot well cross the parallel of 50° S., too far West, on their way to California; provided they keep to the East of 100° or 110°.

To California.

From Cape Horn, Valparaiso, and Callao, to the Line in the Pacific, it is generally thought to be all plain sailing. The only charge which it would seem necessary to give to navigators thither bound, is that they keep well off from the land, in order to be sure of better winds. Those from Cape Horn should aim to enter the S. E. trade wind region of the Pacific as far to the West, provided they keep this side of 115° or 120°, as they well can, without fighting head winds, to make westing, or without turning too much from the direct course when the winds are fair. But when winds are dead ahead, stand off to the Westward, especially if you be South of the trade wind region. Having crossed the parallel of 35° S., and taken the trades, the navigator, with the wind quartering and all sails drawing, should now make the best of his way to the equator, aiming to cross it between 105° and 125°, according to the season of the year, and the directions hereinafter given.

Between the equator and 10° or 12° N., according to the season of the year, the California bound navigator may expect to lose the S. E. and to get the N. E. trade winds.

He will find these last nearest the equator in January, February and March; but in July, August and September, he will sometimes find himself to the North of the parallel of 15° N., before he gets fairly into the N. E. trades. And sometimes, especially in summer and fall, he will not get them at all, unless he keeps well out to the West. Having them, he should steer a good rap full at least, aiming of course to cross the parallel of 20° N., in about 125° W., or rather not to the east of that, particularly from June to November. His course after crossing 20° N., is necessarily to the northward and westward until he loses the N. E. trades. He should aim to reach the latitude of his port without going to the west of 130° W., if he can help it, or approaching nearer than 250 or 300 miles to the land until he passes out of the belt of the N. E. trades and gets into the variables, the prevailing direction of which is westerly.

"Where shall we take the S. E. and lose the N. E. trades on the passage to California?" is an important question for the navigator to have answered, who is striving for a short passage on the west coast of South America. From the parallel of Cape Horn up to the belt of light winds and calms through which you generally pass before getting into the S. E. trades, the prevailing winds are westwardly winds, having northing more frequently than southing in them.

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Between the northwest coast and the meridian of 130° West, from 30° to 40° N., the prevailing direction of the wind in summer and fall is from the northward to the westward inclusive; whereas to the west of 130°, and between the same parallels, the N. E. trades are the prevailing winds of these two seasons. There is a marked difference in the direction of the winds on the opposite sides of the meridian of 130° West in the North Pacific. The cause of this difference has been completely unmasked by the researches connected with these charts. The agent which produces it has its seat in the arid plains of New Mexico, Northern Texas, and the regions around about. At this season of the year, the prevailing winds in the western part of the Gulf of Mexico are from the southward and eastward : *i. e.* towards that great centre of rarification. At this season of the year too, the prevailing winds in the Pacific, off the coasts of Central America, are from the southward, and also towards the same centre of heated plains and ascending columns of air; and we have seen that off the coasts of California, between the parallels of 35° and 40° N., the prevailing winds of this season are from the northward and westward—also towards this great inland "blow hole." In it, is seated a monsoon agent, whose influence is felt for more than a thousand miles out to sea, drawing back the N. E. trades of the Pacific and converting them into a southwardly monsoon for half the year: deflecting the N. E. trades of the Gulf of Mexico, and converting them into a S. Easterly monsoon, during the same season: and so influencing the prevailing S. W. winds off our North West Pacific coast, that they too, are almost made to blow a N. Westerly monsoon.

Therefore vessels bound to San Francisco, should not, unless forced by adverse winds, go any further beyond the meridian of 130° West, than they can help.

Supposing that vessels generally will be able to reach 30° North without crossing the meridian of 130° W.—the distance per great circle from Cape Horn to its point of intersection with that parallel is about 6,000 miles.

And supposing moreover, that California bound vessels will generally, after doubling Cape Horn, be able to cross the parallel of 50° South, between the meridians of 80° and 100° W., their shortest distance in *miles* thence to 30° N., at its intersection with the meridian of 130° West, would be to cross 40° South in about 100° W.; 30° S., in about 104°; 20° S. in about 109°; the equator in 117° West; and 30° N., about 130° W.; (126° if you can.) By crossing the Line 10° farther to the East, or 10° further to the West of 117° the great circle distance from Cape Horn to the intersection of 30° N. with 130° W., will be increased only about 150 miles.

Navigators appear to think that the turning point on a California voyage, is the place of crossing the Equator in the Pacific. But the crossing which may give the shortest run thence to California, may not be the crossing which it is most easy to make from the United States, and it is my wish to give, in these Sailing Directions, the routes which on the average will afford the shortest passages from the United States to California.

First, therefore, let us see which crossings of the Equator in the Pacific give the shortest runs on the average thence to San Francisco; then let us find out which of these crossings it is most easy to reach from Cape Horn, and then by comparing the two, we may be able to lay down the best route from Cape Horn to California.

Independent of the information that has been elicited by these investigations connected with the Wind and Current Charts, but little was known by navigators as to the winds and currents after doubling Cape Horn, on the California route.

Navigators knew indeed that on that route they had to cross the belt both of the S. E. and of the N. E. trade winds. But in what longitude to cross them;—between what meridians are these trade winds most constant, steady and fresh;—and between what meridians is it less difficult to cross the belt of equatorial calms which separate these two systems of trade winds;—and when, at what distance from the coast, are the light airs and calms of the Horse Latitudes, which are found on the polar borders of the S. E. as well as of the N. E. trades, less vexatious? These are some of the questions to which definite answers must be given, before it can be asserted with confidence that this or that is certainly the best route to California.

To enable me to do this I want for every 5° of longitude between the coast and 130° or 140° W., and all the way up, from the parallel of Cape Horn to 40° N., at least one hundred abstract logs for each month. In short, from 10,000 to 15,000 abstract logs of vessels navigating this part of the ocean are wanted, each one of which shall contain faithful reports as to the winds and currents encountered between the western coasts of this continent and the meridians 130° or 140° West, in order that I may point out to navigators the best route for each month, with the assurance that subsequent experience so far from inducing navigators to change, will only confirm them as to the accuracy of this route.

Having exhausted my materials for Pilot Charts of this route, and having found them insufficient as to data for the best tracks, I have overhauled the whole series of log books in my possession, for California passages. From them is derived the following tabular statement, giving the name of the vessel; the year; the number of days' passage from the U. S. generally, to the equator in the Pacific; the place and month of crossing the Equator; and the number of days thence to California. The crossings on the Equator and of various parallels of latitude are also given. The average monthly passages from the U. States to each crossing, and thence to California are also shown. Now if we had the tracks of some one or two hundred vessels for each crossing in each month, we should be able to pronounce with confidence as to the best place for crossing these parallels in the different seasons.

For instance: in March I have the track of but one vessel, the "Acasta," that crossed between 120° and 125° West; and she had a passage to California of 199 days. I have not one in this month that crossed between 95° and 100°; four that crossed between 100° and 105°—but only two of these were direct from the Atlantic ports. The mean passage of these two to California was 141 days. The average of the five that crossed between 105° and 110° was 134 days; and of the four that crossed between 115° and 120°, the average passage was 132 days. In all for March from the Line to California, we have the logs of twenty-one vessels; and it appears from these that the average passage from the Line to California is the same, (28 days,) whether you cross in 100° or 125° or at any intermediate point.

Nevertheless, if we examine the ships that made the several crossings, we shall find, in some cases at least,

that the difference in time between the United States to these places of crossing in the Pacific is owing quite as much to difference in the sailing qualities of the several vessels, &c., as to any difference in the winds and currents encountered by the way.

Table showing the names of vessels; their passage from the Atlantic to the line in the Pacific; the time and place of crossing the Equator, with the passage thence to California, for each month.

Name of vessel.	Port last from.	To the Equator in Pacific.	Date of crossing the Equator in Pacific.	Longitude of crossing the Equator.	From the Equator to San Francisco.	Average Passage: To the Line, from U. S.	Average Passage: From Line to California.	Average Passage: From U. S. to California.
		Days.			Days.	Days.	Days.	Days.
Loo Choo	Valparaiso	22	Feb. 14, '47	96° 20' W.	39		39	
Whiton	New York	107	Mar. 13, '47	93 15	42	107	42	149
Ocean Bird	"	140	May 24, '49	99 25	38	140	38	178
Stag Hound	"	91	June 1, '52	99 20	34	91	34	125
Louisa Bliss	Beaufort, N. C.	153	June 8, '50	100 00	52	153	52	205
Chatham	Boston	130	Sept. 22, '49	99 15	39	130	39	169
Angelique	Valparaiso	15	Oct. 29, '49	99 13	44		44	
U. S. ship Falmouth	. . . . .	. .	Nov. 11, '49	91 00	33		33	
Crossing between 100° and 105° W. Long.								
Europe	New York	114	Mar. 17, '52	100 00	35			
Heber	Valparaiso	25	3, '51	102 40	31	112.5	28	140.5
Hurricane	Rio de Janeiro	57	22, '52	103 20	24			
George Brown	Philadelphia	111	14, '51	104 45	22			
Seaman's Bride	Valparaiso	18	April 22, '52	103 45	27	110	28.5	138.5
Great Britain	New York	110	28, '52	104 30	30			
Anonyma	Boston		May 23, '49	102 40	34		34	
Sea Serpent	New York	88	June 5, '52	101 72	25			
Forrest	St. Catherine's	62	6, '49	104 10	30			
Governor Morton	New York	91	12, '52	101 43	32	102	32.5	134.5
Sweden	Boston	117	26, '49	102 20	38			
Michael Angelo	New York	113	27, '52	102 09	36			
Thomas B. Wales	Boston	100	July 3, '52	102 51	33			
Empire	New York	97	8, '52	102 01	35	103	37	140
Tellassar	Valparaiso	18	21, '50	100 00	46			
North America	New York	112	27, '52	100 27	34			
Queen of the East	Callao	12	Aug. 8, '52	100 48	30	91	29	120
Union	New York	91	31, '52	101 10	28			
Carioca	Philadelphia	116	Sept. 6, '52	100 56	41	117.5	40.5	158
Copeland	Boston	119	7, '52	103 43	40			
Cohota	"	110	Oct. 5, '52	104 09	26	98	24	122
Sea Witch	New York	87	27, '51	101 30	23			
Raven	"	93	Nov. 2, '52	104 32	29	93	29	122
Crossing between 105° and 110° W. Long.								
Wild Pigeon	New York	88	Jan. 10, '52	108 59	17	89	20	109
Golden Gate	"	90	12, '52	106 00	23			
John Jay	New Bedford	133	Feb. 6, '50	105 10	37			
Sarah	Tombez	16	14, '50	108 45	28			
Hazard	New York	107	21, '51	109 30	24	120	29.5	149.5
Helena	"	113	19, '51	110 00	21			
Russell	"	128	7, '50	110 00	37			
Imaum	Valparaiso	21	Mar. 3, '50	106 15	31			
Sartelle	New York	135	29, '50	107 15	34			
Whiton	"	112	15, '48	109 05	28			
Samuel Appleton	"	103	23,	109 30	18	106	28.5	134.5
Uriel	Boston	86	30, '51	109 45	34			
Benjamin Howard*	"	95	29, '52	110 00	25			

* *Capt. Shrieve to Lieut. Maury:* I approve of the route laid down by you. I have had much experience at sea, as shipmaster, in all quarters of the globe, and heartily concur in your views respecting passages. I also believe the day is not far distant when passages to California will be made frequently in one hundred days. I have often been amazed in viewing tracks of different ships to this port, and those who have the longest passages have been broad off the *right track*. The "Benjamin Howard" is a medium clipper, seven hundred tons. You will notice I have beat the whole fleet that sailed about the time I did; experienced all sorts of weather on the passage; neither tore a sail nor lost a spar the whole passage.

TABLE—*Continued.*

Name of vessel.	Port last from.	To the Equator in Pacific.	Date of crossing the Equator in Pacific.	Longitude of crossing the Equator.	From the Equator to San Francisco.	Average Passage: To the Line, from U. S.	Average Passage: From Line to California.	Average Passage: From U. S. to California
		Days.				Days.	Days.	Days.
Wisconsin	New York	94	April 22, '52	106°00'W.	30			
Herman	Philadelphia	155	11, '50	109 00	37	124.5	41	165.5
Harvest	Valparaiso	25	19, '50	109 30	39			
Burlington	Talcahuana	26	8, '51	110 00	59			
Gray Feather	New York	108	May 1, '51	109 45	28			
Tornado	"	84	17, '52	107 07	44	110	34	144
Aurora	Nantucket	140	30, '49	110 00	31			
Kate Hayes	New York	122	June 3, '52	109 16	31			
America	Valparaiso	22	15, '50	106 30	45			
Elizabeth	"	26	19, '50	107 00	49			
General Warren	"	24	4, '50	107 30	37			
Vandalia	New York	126	2, '50	107 30	36			
Masconomu	"	123	4, '50	108 00	45			
Sherwood	Boston	106	June 25, '51	108 45	40	120	39	159
Wild Pigeon	New York	89	10, '52	108 45	18			
New Castle	"	157	11, '49	109 30	54			
Ino	"	99	19, '51	109 30	34			
Adirondack	"	151	12, '50	109 40	49			
Home	Baltimore	109	10, '50	110 00	39			
Gazelle			July 9, '49	105 30	30			
Florence	Valparaiso	20	6, '49	106 00	50			
Will	"	24	11, '50	107 30	35			
Edgar	New York	126	2, '50	108 15	39	104	33	137
U. S. ship Savannah	Callao	13	24, '49	109 30	33			
Staffordshire	Boston	83	24, '52	108 01	18			
Cohota	"	103	19, '50	109 45	23			
Frances	Valparaiso	18	Aug. 8, '51	106 18	39		39	
Mermaid			Sept. 21, '51	105 45	27	141	26	167
Eureka	New York	141	15, '51	108 20	25 Port	Bodega		
U. S. ship Yorktown	Callao	37	Oct. 3, '42	105 30	24			
Butler			25, '49	108 00	26			
Fenelon	Valparaiso	25	25, '52	105 02	36	102	28	130
Samuel Edward	Talcahuana	28	11, '50	109 00	33			
Telegraph	New York	102	22,	109 30	23			
Defiance	Rio de Janeiro	63	Nov. 7, '52	105 24	24		32	
Boston	"	81	27, '49	106 00	40			
Stately	Valparaiso	26	Dec. 8, '51	105 45	36			
Horton	New York	151	23, '50	109 15	33	151	30.5	181.5
Emma	Orange Bay	49	14, '49	110 00	22			

Crossing between 110° and 115° W. Long.

Name of vessel.	Port last from.	To the Equator in Pacific.	Date of crossing the Equator in Pacific.	Longitude of crossing the Equator.	From the Equator to San Francisco.	To the Line, from U. S.	From Line to California.	From U. S. to California
Sword Fish	New York	71	Jan. 21, '52	110 15	20			
Corea	Valparaiso	25	23, '50	110 45	33	94	27	121
Ambassador	New York	127	16, '49	112 35	32			
Celestial	"	84	23, '52	113 30	23			
Cygnet	"	118	Feb. 26, '50	111 15	29	126	27.5	153.5
Lawrence	"	134	28, '50	113 45	26			
Surprise	"	80	Mar, 3, '51	110 30	17			
Winthrop	Boston	116	3, '51	110 30	29			
Potomac	Portland	133	3, '51	111 20	32	114	29	143
Bothnia	New York	123	24, '51	112 15	25			
Hannibal	Boston	120	22, '50	114 45	40			
Genessee	Juan Fernandez	27	11, '51	114 45	29			

TABLE—*Continued.*

Name of vessel.	Port last from.	To the Equator in the Pacific.	Date of crossing Equator in Pacific.	Longitude of crossing the Equator.	From the Equator to San Francisco.	Average passage. To the Line, from U. S.	From Line to California.	From U. S. to California.
		Days.				Days.	Days.	Days.
Russell Glover	New York	115	April 14, '50	113°00′W.	21			
Daniel			28, '51	113 15	33	115	26	141
Sea Serpent			22, '51	114 15	25			
Isette	Gloucester	140	May 10, '50	110 15	37			
Siroc	Rio	101	11, '50	111 45	35			
F. Depau	New York	139	20, '50	112 45	27	124	32	152
Stag Hound	"	93	4, '51	113 30	21			
Byron	Valparaiso	26	31, '50	110 42	42			
Henry Pratt	Rio	85	June 7, '50	110 30	41			
Archibald Gracie	Boston	111	June 11, '50	111 00	36			
Delia	New York	128	10, '51	114 00	34	120	34	154
Tigress	Salem	132	1, '50	114 30	33			
Rose Standish	New York	111	20, '50	113 00	45			
Mary Reed	Valparaiso	24	25, '49	115 00	16			
Helen McGaw	"	21	July 4, '51	110 30	40 *			
Zenobia	"	29	14, '50	114 30	30			
Clarissa Perkins	Rio	79	30, '49	114 32	43	119	35	154
Venice	New York	107	14, '50	114 45	30			
Amity	Boston	132	15, '50	115 00	31			
St. Patrick	New York	118	Aug. 14, '50	110 45	34			
Isaac Allerton			13, '50	111 15	34			
Primoquet	Valparaiso	24	28, '50	112 45	33			
Caroline	New York	127	11, '50	113 30	36	120	32	152
Sarah and Eliza	"	180	12, '49	113 40	36			
N. B. Palmer	"	88	2, '51	114 00	19			
Witch of the Wave	Boston	89	18, '51	115 00	32			
Almeida	Talcahuana	23	Sept. 2, '50	112 00	26			
Templeton	Bucksport	126	10, '50	112 30	27			
Lady Arabella	New York	138	4, '50	113 00	33			
Virginia			2, '50	114 00	33	118	30	148
Witch of the Wave	Boston	90	21, '52	113 50	25			
Clyde	Valparaiso	25	26, '49	114 20	37			
Thomas Perkins	New York	100	Oct. 25, '49	110 45	26			
Columbia	Boston	133	12, '50	111 45	35			
Raven	"	85	29, '51	112 00	20			
Typhoon	New York	87	30, '51	114 41	19	99	25	124
Eagle	"	101	20, '51	115 00	28			
Carrington	"	103	5, '50	115 00	26			
Celestial	"	83	11, '50	115 00	21			
Talbot	"	139	Nov. 12, '50	115 00	31			
Valparaiso	"	138	2, '51	115 00	30			
Winged Arrow	Boston	95	4, '52	114 39	22	116	25	141
Sea Witch	New York	91	22, '52	114 10	17			
Hope	Valparaiso	25	23, '49	115 00	26			

Crossing between 115° and 120° W. Long.

Name of vessel.	Port last from.	To the Equator in the Pacific.	Date of crossing Equator in Pacific.	Longitude of crossing the Equator.	From the Equator to San Francisco.	To the Line, from U. S.	From Line to California.	From U. S. to California.
Flying Fish	Boston	77	Jan. 22, '52	119 50	23	77	23	100
Seaman	New York	89	Feb. 20, '50	118 00	18	89	18	107
Southerner	"	120	Mar. 30, '51	117 00	28			
Newton	Boston	124	10, '51	117 10	26			
Canton	New York	136	28, '49	118 00	29	105	28	133

* To Monterey.

TABLE—*Continued.*

Name of vessel.	Port last from.	To Equator in the Pacific.	Date of crossing the Equator in Pacific.	Longitude of crossing the Equator.	From the Equator to San Francisco.	Average passage.		
						To the Line, from U. S.	From Line to California.	From U. S. to California.
		Days.			Days.	Days.	Days.	Days.
Audubon	Valparaiso	23	Mar. 29, '51	118°30′W.	27			
Lucia Field	Boston	120	19, '51	119 15	31			
Isabelita Hyne	New York	101	April 23, '51	116 00	24			
Maria	"	111	16, '51	117 00	32	101	25	126
Samuel Russell	"	90	15, '50	118 30	20			
Diadem	"		May 22, '50	116 00	36			
Arcole	Philadelphia	105	31, '50	117 00	30	106	29	125
Wisconsin	New York	100	31, '50	118 45	24			
Valparaiso	"	114	31, '50	119 00	28			
Houqua	"	103	June 25, '50	115 15	28	103	28	131
Sarah Boyd	Philadelphia	129	July 15, '50	115 15	32			
Lowell	Valparaiso	24	3, '50	116 00	31			
Raduga	New York	116	28, '51	118 00	25	114.5	28.5	143
Sheridan	"	103	2, '50	118 30	28			
Herman	"	110	30, '49	120 00	27			
Finland	Philadelphia	133	Aug. 6, '50	117 15	42	133	42	175
Vernon	Valparaiso	14	Sept. 2, '49	119 30	33	.	33	
Gertrude	New York	116	Oct 8, '50	116 00	30	99.5	25	124.5
Sovereign of the Seas	"	83	27, '52	119 47	20			
Comet	"	88	Dec. 28, '51	117 00	16	88	15	103
White Squall	Rio	59	24, '50	118 20	14			

Crossing between 120° and 125° W. Long.

Name of vessel.	Port last from.	To Equator in the Pacific.	Date of crossing the Equator in Pacific.	Longitude of crossing the Equator.	From the Equator to San Francisco.	To the Line, from U. S.	From Line to California.	From U. S. to California.
Acasta	Sag Harbor	171	Mar. 10, '51	120 30	28	171	28	199
Kensington	New York	129	June 24, '51	122 45	39	129	39	168
Tartar	Philadelphia	104	July 24, '51	121 30	30	104	30	134
Flying Cloud	New York	71	Aug. 12, '51	124 00	19	71	19	90

Crossing West of 125° W. Long.

Name of vessel.	Port last from.	To Equator in the Pacific.	Date of crossing the Equator in Pacific.	Longitude of crossing the Equator.	From the Equator to San Francisco.	To the Line, from U. S.	From Line to California.	From U. S. to California.
Tagus	New York	126	June 15, '51	128 00	46	126	46	172
U. S. S. Falmouth	From S. Pacific		April 13, '51	173 16	38		38	

From this table, we have the following summary of the passages and crossings—showing the average time for each month to and from each crossing place, of 5° of longitude in length.

THE CALIFORNIA PASSAGE.

Average length of passages of California bound vessels from the Atlantic ports of the U. S. to the Equator in the Pacific, and from the Equator in the Pacific to San Francisco—arranged according to the month and the Longitude of crossing the Equator.

Month of Crossing the Equator in the Pacific.	From the U.S. to the Equator in the Pacific.	Number of Passages from which Av'rages are determin'd.	Averages from the Equat'r to Calif'nia.	Number of Passages from which Av'rages are determin'd.	Place of Crossing the Equator in the Pacific.	Average fr'm the U. S. to California.	Average Pas'ges of the whole month from U. S.	Shortest Passage from the U. S., for the month.
	Days.		Days.		Between.	Days.	Days.	
January . .	89	2	20	2	105 and 110	109		By the
	94	3	25.5	4	110 " 115	*119		Sword Fish, 91 days.
	77	1	23	1	115 " 120	100	112.5	
February .			39	1	95 " 100			
	120	4	30	5	105 " 110	150		
	126	2	27	2	110 " 115	153		
	89	1	18	1	115 " 120	*107	144.7	Seaman, 107 days.
March . .	107	1	42	1	90 " 95	149		
	112.5	2	28.5	3	100 " 105	141		
	106	5	28	5	105 " 110	134		
	115	5	28	6	110 " 115	*132		Surprise, 97 days.
	104	4	28	5	115 " 120	132		
	171	1	28	1	120 " 125	199	141	
April . .	110	1	28.5	2	100 " 105	138.5		
	124.5	2	33.5	4	105 " 110	158		
	115	1	26	3	110 " 115	141		
	100	3	26	3	115 " 120	*126		Samuel Russell, 110 days.
May . . .	140	1	38	1	90 " 100	178		
			34	1	100 " 105			
	124	2	34.4	4	105 " 110	148.2		
	116	3	27.7	5	110 " 115	140		
	106	4	27	4	115 " 120	*133	142.6	Wisconsin, 124 days.
June . . .	102.2	4	32.2	5	100 " 105	134.5		
	120.5	4	38.4	12	105 " 110	*157.5		Wild Pigeon, 107 days.
	110.2	5	33	7	110 " 115	142		
	103	1	28	1	115 " 120	131		
	129	1	39	1	120 " 125	168		
	126	1	46	1	W. of 125	172	146.8	
July . . .	103	3	37	4	100 and 105	131		
	108	4	29	7	105 " 110	*134		Staffordshire, 101 days.
	119.5	2	30.5	5	110 " 115	150		
	114	4	25	5	115 " 120	139		
	104	1	30	1	120 " 125	134	137	
August . .	91	1	29	2	100 " 105	119		
			18	1	105 " 110			
	120	5	32	7	110 " 115	152		
	133	1	42	1	115 " 120	175		
	71	1	19	1	120 " 125	90	143	Flying Cloud, 90 days.
September .	130	1	39	1	95 " 100	169		
	117.5	2	33	2	100 " 105	150.5		
	141	1	25	2	105 " 110	166		
	118	3	29	6	110 " 115	*126.3		Witch of the Wave, 115 days.
			33	1	115 " 120		145	
October . .			44	1	95 " 100			
	90	2	26	2	100 " 105	116		
	102	1	25.7	5	105 " 110	125		
	99	7	25	7	110 " 115	124		
	99.5	2	25	2	115 " 120	*124.5	134	Sovereign of the Seas, 103 days.
November .			33	1	90 " 95			
	93	1	29	1	100 " 105	122		
	102	1	23	4	105 " 110	125		
	115.5	4	25.2	5	110 " 115	*139.7	134.3	Sea Witch, 108 days.
December .	151	1	35	3	105 " 110	184		
	88	1	15	2	115 " 120	*103	143	Comet, 104 days.

Let us see what light the information contained in these two tables will throw upon the best California route.

It is worthy of remark that the crossing between 115° and 120° W., gives the shortest *average* for each of the months of January, February, March, April, May and June, and that the shortest passage for each of the months of February, April, May, October, and December, was also made by crossing the line between the same meridians of 115° and 120°.

The next best crossing on the average appears to be between 110° and 115°, though crossings enough for comparison to the West of 120° are wanting.

The shortest passage was by the "Flying Cloud" that crossed between 120° and 125° in October; the next shortest was by the "Sword Fish" that crossed between 110° and 115° in January; and the next from the same crossing by the "Surprise" in March.

In July the best average—and "bad's the best"—is between 100° and 105°, 131 days. In October it is for the same crossing with 116 days. In November from the same with 122 days.

The crossings that give the shortest passages for each month are marked in table p. 441 with an asterisk (*.)

But these so called averages are derived sometimes from a single vessel; and sometimes the means of comparing the passages at one crossing with those at another, are wanting. For instance, we have no record of any vessel that crossed the line between 90° and 95° in any month, except one in March and November. Between 95° and 100°, we have two for May, and one only for February and October each. Therefore we have not the means of instituting any satisfactory comparison as to the advantages of crossing in these months between 95° and 100°, with the advantages of crossing between 100° and 105°; or between 110° and 115°, or elsewhere in the same months.

In January there is no vessel that crossed East of 105°. We have two that crossed between 105° and 110°; four that crossed between 110° and 115°; and one between 115° and 120°.

The shortest passage to the Line for any month from the United States was by the "Flying Cloud," and the "Sword Fish," each of 71 days.

The "Sword Fish" crossed in 110° in August, she had 20 days thence to San Francisco. The "Flying Cloud" crossed at 124° in August, and had 19 days thence to port. The shortest trip yet from the Equator to San Francisco was made in 14 days by the "White Squall"—she crossed at 118° W. in December. The next shortest is the "Comet," from Long. 117° in December, the "Mary Reed" from 115 in January, each of 16 days.

In February there are no means of comparing crossings to the East of 105°. Five vessels, however, crossed between 105° and 110° W., of which the shortest to the Line was the "Hazard," 107 days, in Long. 110°; and the shortest from the Line was the "Helena," 21 days, she crossed at 110°. Between the meridians of 110° and 115° there were two crossings in February, and between 115° and 120°, one. This vessel, the "Seamen," clipper, crossed in 118° with 87 days from the United States to the Line, and 18 thence to San Francisco.

Certainly no conclusions can be safely drawn from these data, as to the best crossing for either of these two months.

The passages for March have already been discussed, and it appears from the statistics involved in that discussion, that the Line, so far as the passage thence to California is concerned, may be crossed with equal advantage, anywhere between Long. 100° and Long. 125° West. From 110° to 115° will probably be found the best crossings for this month.

The place of crossing in March, appears to be governed by the winds encountered between Cape Horn and the region of S. E. trade winds in the Pacific.

Therefore, after doubling Cape Horn in January or February, if the winds should be free for a N. W. or a W. N. W. course, make the best of them; aiming to cross, if with convenience you may, the parallel of 50° S. between 80° and 90°; of 40° between 90° and 100°; of 30° South, to the West of Long. 105°; so that you may catch the S. E. trades somewhere between that meridian, of 110° West. The meridian even of 115°, will not be too far West for entering the S. E. trades. But you are not to beat or to jam upon a wind to make westing in this part of the voyage.

Having taken these winds near these meridians, your course then will be mostly due North with the wind quartering.

In March you will occasionally carry the S. E. trades several degrees over into the Northern Hemisphere. When you lose them and get the N. E. trades, keep away with a good rap full aiming never to cross the parallel of 20° North to the East of Long. 125° West. Unless the winds force you off, aim to be in shore of the meridian of 130° W. when you lose the N. E. trades.

When you do lose them, if then you have to fight the calms and baffling winds of the Horse Latitudes, make the best of your way on a due North course, till you cross this belt of calms and get into the variables beyond. I shall have more to say upon this subject at a subsequent page of this work.

In April, we have the abstracts of two vessels that crossed between 100° and 105°, with an average of 28½ days thence to California; of 4 between 105° and 110° with an average time of 33½ days; of three between 110° and 115°, with an average of 26 days; and of three between 115° and 120°, with an average also of 26 days thence to California. The average of the last three from the United States to California happens to be 12 days less than the average by any other crossing in this month.

We have but one vessel direct from the United States to California that crossed between 100° and 105°. She is the "Great Britain," a vessel 25 years old and a dull sailer. The other vessel that crossed between these two meridians, was the "Seaman's Bride." She had 27 days thence to California.

The vessels that crossed in April between 115° and 120° were the "Isabelita Hyne," the "Marie," and the "Samuel Russell"—clipper. Therefore considering the insufficiency of data, I would repeat here the suggestions already offered concerning the route for crossing the line in March.

In order to make westing in the high latitudes about the parallels of Patagonia, and after doubling Cape Horn, navigators are recommended to do that only in case their winds allow it. For it should be borne in

mind that on account of the absence of great deserts in South America, that that continent by reason of its windward position with regard to the S. E. trades, interferes less with their strength and regularity than large bodies of land do generally, when, with extensive deserts and arid plains, they are to windward of the trades. Thus Africa, with its deserts, is to the windward both of the N. E. and S. E. trades of the Atlantic. And what have we? Why a total interruption of the trades along its Atlantic coasts, and a navigation the most tedious and perplexing, along its inter-tropical shore lines.

Again, consider the baffling winds along the western coasts of inter-tropical North America. Here, on account of agencies already explained, the N. E. Trade winds are overpowered, and the navigation of the Pacific coasts of Central America rendered very, very tedious.

Now, off the Pacific coasts of South America, we have no such agents as great deserts in the interior to interrupt the S. E. trades, and consequently no such regions of calms, "little monsoons," and baffling winds, to try the patience of navigators, as we have under the lee of trade-wind Africa, and of trade-wind North America.

Therefore, after you have doubled Cape Horn, and gained an offing from the land, there is no necessity for running a thousand miles or more off from the South American coast, as from the coasts of Central America you have to do, in order to get better winds. The chief advantage of making, while South of the parallel of 35° or 40° S., the meridian near which you intend to cross the equator, is, that there the degrees of longitude are short, and therefore easy to run down; and that when you have made your westing down there, you can spread the more canvass when you get the S. E. trades which you will then have on the quarter. If you put off making westing until you get these winds, you will then have to stand away to the Northward and Westward through them, which course will bring them aft, and therefore make them less favorable.

In April you will carry them generally a little further beyond the Line than in March.

In May, the experience of the ten navigators who crossed between the meridians of 105° and 127° would, at first sight, seem to indicate that between 115° and 120° is the best crossing for this month. But when we come to consider the sailing qualities of the vessels concerned, we find reason to believe that the difficulties of the passage do not depend upon where you cross the Line in May, provided you do not cross to the East of 100°; but the difficulties are at other turning points to be mentioned hereafter.

The three vessels from the United States whose crossings turn the scale in favor of these two meridians are all fast ships. One of them, the "Wisconsin," is a clipper. She crossed in 119°—100 days from New York—and had 24 days thence to California. On the other hand, of the three from the United States that crossed between 110° and 115°, one also was a clipper, viz: the "Stag Hound." She crossed in 113°—93 days from New York;—she had 21 days thence to San Francisco. Of the three that crossed between 105° and 110°, two were clippers, and the other dull. The "Grey Feather," clipper, crossed in 110°—108 days from New York;—she had 28 days thence to port. The "Tornado," clipper, crossed in 107°, 84 days from New York. She had 44 days from this crossing to San Francisco. Bad Luck.

It appears therefore, with the feeble light which these passages afford as to the best California route for

crossing the line in May, that the suggestions which I have already made with regard to the route for crossing in March and April, may be repeated for May, also; only for May a route a little more to the Westward would be well.

In this month the navigator may carry the S. E. trades, (and the N. E. trades also,) farther North, than he will in April or March. In neither of these months will he find the belts of equatorial calms and the light airs of the "Horse Latitudes" very difficult to cross. His course across them should be as nearly due North as he can make it.

The June passages give us a little more experience as to the relative advantages of certain crossings. This month affords data for drawing a comparison as to the crossings between 100° and 105°, 105° and 110°, 110° and 115°. From the first crossing we have the passages of four vessels to California; from the second, twelve, and from the last, six.

Among the first were the "Sea Serpent" and "Governor Morton," the one having 88, the other 91 days, from New York. Among the second were the "Wild Pigeon," and the "Ion," having 89 and 99 days, respectively, from New York to the Line—18 and 34 days thence to San Francisco.

Among the six which crossed between 110° and 115°, I recognize no clipper. The "Mary Reed," which vessel I do not know, came from Valparaiso. She crossed in 115° and had 16 days thence to San Francisco.

It appears therefore that, as far as this table is concerned, we are left in as much doubt as to the best crossing in June, as we are with regard to other months; though the indications seem to suggest, and other circumstances indicate, that in this month vessels should not cross to the East of 105°. Perhaps near 120° will be found the best crossing place; for the reason that there, the belt of equatorial calms will not be so difficult to cross: that in this month also, the S. E. trades will sometimes be carried as far as 10° N.: and that the N. E. trades are better winds the farther you are from the American coast.

July seems to be one of the most difficult months for a good passage from any crossing to California. The influence upon the winds, of the Great Salt Desert and other arid plains of the interior, begins now to be felt far out to sea. The effect is, uncertain and light N. E. trades, with a broad belt of equatorial calms.

I do not recognize a single clipper among the ships that have crossed the equator in the Pacific in this month. Among the 22 July crossings, the "Staffordshire," and the "Cahota," from 108° and 110° W., give the shortest passages—the former of 18, the latter of 23 days to San Francisco.

But the indications are, that by crossing in this month between 115° and 120°, or even to the West of 120°, you will have a more certain passage, and on the average, one that is shorter than you will make by crossing further to the eastward.

In August, the data are very meagre. In this month we have the tracks of three clipper ships, viz: the "N. B. Palmer," that crossed the Line 88 days from New York, in 114°, with 19 days thence to California; the "Union," that 91 days out crossed the Line in 101°, with 28 days thence to San Francisco; and the

"Flying Cloud," that in 71 days from New York, crossed the Line in 124° West, having 19 days thence to San Francisco.

This passage of the "Flying Cloud," is one of the most remarkable that has ever been made under canvas, in any quarter of the world.

Navigators bound to California at the season of the year in which she went, may study her log with advantage. I therefore quote it at length.

ABSTRACT LOG OF THE SHIP "FLYING CLOUD," J. P. CREESY, COMMANDER, BOUND FROM NEW YORK TO SAN FRANCISCO, JUNE 2, 1851.

Date.	Latitude. at noon.	Longitude, at noon.	Distance.	WINDS. First part.	WINDS. Middle part.	WINDS. Latter part.	REMARKS.
1851							
June 3	39°27′	70°47′	164	W. N. W.	S. W.	N. W.	Moderate breezes, with fine weather.
4	38 49	67 47	145	N. W.	W. N. W.	W.	Light breezes.
5	37 25	63 17	228	W. N. W.	"	N. W.	Gentle breezes.
6	36 36	57 15	293	N. W.	N. W.	"	Good breezes—lost main and mizzen top-gallant masts, and main topsail yard.
7	36 09	55 18	98	"	W. S. W.	W. S. W.	Good breezes—sent up top-gallant masts and yards. Middle and latter, light.
8	35 34	51 07	206	S. S. W.	S. ½ E.	S. ½ E.	Gentle breezes—sent up main topsail yard, and set all possible sails.
9	33 59	45 39	209	S. ½ E.	"	S. by W.	Gentle breezes, with heavy weather.
10	32 16	40 59	256	S. by W.	S. by W.	S. S. W.	Gentle breezes, with heavy weather.
11	30 48	39 52	105	S. S. W.	S. S. W.	"	Very light breezes, with fine weather.
12	29 54	39 47	54	S. by W.	S. by W.	S. by E.	Faint airs and calms, fine weather.
13	27 41	40 22	137	S. S. E.	S. E. by S.	Calm.	Faint airs and calms, fine weather. Latter part calm.
14	24 50	40 23	171	S. E. by E.	S. E. by E.	S. E. by E.	Light breezes, discovered mainmast badly sprung about a foot from the hounds, and fished it.
15	21 21	40 10	210	"	"	"	Gentle breezes and calms, fine weather, with passing clouds.
16	17 10	39 12	257	"	"	"	Gentle breezes and puffy, fine weather. Middle and latter, fresh and puffy.
17	12 50	37 54	272	S. S. E.	E. by S.	E.	Fresh breezes, with light squalls of rain—weather cloudy.
18	9 29	35 18	261	E. by S.	"	E. N. E,	Fresh breezes and squally, with frequent showers.
19	6 49	32 33	229	N. E.	N. E.	S. E.	Fresh breezes and squally, with rain. Latter, faint airs.
20	6 04	34 03	101	S.	S. S. E.	Calm.	Baffling airs and fresh squlls—tacked 6 times. Ends calm.
21	5 27	32 50	82	Calm S. S. W.	N. W.	"	Middle, light squalls, with rain, 40 miles easterly current.
22	5 11	32 00	52	Calm.	Calm.	"	Occasional faint airs, weather fine, 20 miles easterly current.
23	4 33	31 23	53	"	E.	"	Middle, faint airs, with squalls and rain.
24	1 37	32 50	197	S. E.	S. E. by E.	S. E. by S.	Faint airs. Middle and latter, gentle breezes and fine weather.
25	1 56 S.	33 26	216	E. S. E.	E. S. E.	E. S. E.	Gentle breezes, with fine weather.
26	4 39	33 26	163	"	"	"	Gentle breezes, at midnight tacked ship to clear Roces shoals.
27	7 27	33 20	168	"	"	"	Very light breezes, with fine weather.
28	9 45	34 31	155	"	"	S.	First and middle, light and fine weather. Latter, squally with rain.
29	10 59	35 16	87	S.S. W. Calm.	S.	S. S. E.	First and middle, fresh with heavy squalls; one reef in main topsail, with top-gallant sail set over it. Tacked twice.
30	12 54	37 20	167	S.	S. S. E.	S.	First and middle, fresh with heavy squalls.
July 1	13 49	37 02	58	South.	Calm.	S. by E.	Light and baffling, and squally—middle mostly calm—tacked twice.

ABSTRACT LOG OF THE SHIP "FLYING CLOUD,"—CONTINUED.

Date.	Latitude, at noon.	Longitude, at noon.	Distance.	WINDS. First part.	WINDS. Middle part.	WINDS. Latter part.	REMARKS.
July 2	15°10′ S.	38°00′W.	99	S. S. E.	South.	S. E. by E.	Light and baffling, with fine weather—tacked at 8 p. m. to S. and E., at 1 a. m. to S. W. by S.
3	17 27	38 35	138	S. E. by S.	E. S. E.	E. S. E.	Very light airs and fine weather—land in sight all day.
4	19 16	38 29	112	E. by S.	Easterly.	E. N. E.	Very light calms at times, with occasional showers, at 2 p. m. 20 fathoms water, and at 6, 17, from 17 to 35, and down to 20, up to middle at 1 a. m., 35 fathoms.
5	21 33	38 50	139	E. N. E.	E. N. E.	E. N. E.	Light breezes, with fine weather—latter part cloudy, with light showers and squally appearances.
6	24 22	40 00	181	N. E.	N. E.	N. E.	Light breezes, with thick hazy weather—latter part fine—all possible sail set.
7	26 54	44 17	192	N. E.	N. E.	N. N. E.	Light breezes, with thick hazy weather—all sail set.
8	29 33	44 26	200	N. N. E.	N. E.	N. E.	Light breezes, and thick hazy weather—all sail set.
9	32 50	49 00	300	N. N. E.	North.	North.	Light breezes, and thick weather—middle fresh—latter unsteady, with thunder, lightning, and much rain, ends faint and baffling air.
10	34 58	51 24	175	N. W.	N. W.	West.	Light breezes, with thunder and lightning, and much rain. Middle very heavy squalls, with much rain, and got no observation.
11	36 32	49 36	128	W. S. W.	S. W.	S. W.	Very severe thunder and lightning—double reefed topsails—latter part blowing a hard gale, close reefed topsails, split fore and main topmast staysails. At 1 p. m., discovered main mast had sprung. Same time brig in company to leeward—lost fore and main topmasts. Sent down royal and topgallant yards, and booms off lower end topsail yards to relieve the masts—very turbulent sea running. Ship laboring hard, and shipping large quantities of water over her rail. Middle and latter parts hard gales and harder squalls. No observation.
12	37 02	50 09	40	S. W.	S. W.	South.	Heavy gales and sea. At 3 p. m. wore ship to N. W. after removing.
13	36 43	53 53	180	S. S. W.	S. W.	S. W. by S.	Comes in fresh breezes, and cloudy. Let the men out of irons in consequence of wanting their services, with the understanding that they would be taken care of on arriving at San Francisco. At 6 p. m., carried away main topsail tie and truss band round the main mast. Single reefed the topsails. Middle, fresh breezes and pleasant; moon eclipsed at 3 h. 30 m., a. m. Latter part moderate and clear, 19

							inches water in the ship, having six inches more than usual.
14	37 55	57 23	182	S. by E.	S. S. E.	E. S. E.	Comes in moderate—all sail set on fore and mizzen masts. Middle and latter parts, same weather; ship making as before the gale.
15	41 28	61 07	274	N. W.	N. W.	W. N. W.	Comes in moderate breezes and fine weather. At 4 p. m., saw the land W. N. W., 25 miles distant. Middle part fresh winds and cloudy, with light rain squalls. Latter light breezes and cloudy. No observations.
16	44 23	63 29	302	Calm.	S. E.	N. E.	First part light airs and calms—middle and latter parts fresh and baffling breezes with cloudy weather. No observations. Spoke ship "Harriet Raymond," reports leaving Boston 4 days before ship "Flying Cloud" left same place for New York.
17	47 32	64 55	199	N. E.	E. S. E.	E. S. E.	Light breezes with thick weather—latter moderate. No observations.
18	48 56	65 30		S. E.	E. S. E.	E. S. E.	Comes in S. E. airs with drizzling rain—4 p. m. in studding sails. 10 h. 30 m. sounded 65 fathoms. Middle and latter part light rains, sometimes calm weather—still thick. No observations.
19	49 39	66 17		Calm.	N.	N.	Mostly calm thick weather—sometimes rain.
20	54 25	65 00	287	E. N. E.	E. N. E.	E. S. E.	Comes in light—increasing breezes from N'd and veering gradually from E. N. E.—weather cloudy. At 3 h. 30 m. set larboard studding-sails—at 10 h. in studding sails—weather rainy, with sleet, and squally. Middle, in top-gallant sails—at 4 a. m. close reefed top-sails and furled courses—wind blowing hard gale—at 11, hard gale with thick weather and snow—obliged to wear ship, and haul off to clear Cape St. Diego, bearing S. 9° W., distant 10 miles by estimate—ends same weather and winds. No observations.
21	54 02	65 00		S. E.	S. E.	S. E.	Blowing hard with snow and rain—at 10 a. m. saw large ship N. E. with loss of fore-sail.
22	54 41	64 50		E. S. E.	S. E. by E.	East.	Hard gale with rain and sleet—Ship shipping much water—bad sea running—at 4 p. m. weather fair—saw Cape Diego, bearing S. E. 15 miles. Wore ship at 5 p. m. to N. E.—at 6 a. m. wore ship S'd—at 10 h. saw the land bearing S. 20 miles distant—at meridian St. Diego west 10 miles, weather moderate and cloudy.
23	56 04	68 16		East.	East.	East.	Moderate breezes—all sail set—passed through the Straits of Le Maire, and cleared the land at 6 p. m.—strong tide setting to N.—night rainy—at 8 a. m. Cape Horn North 5 miles.—The whole coast covered with snow. Wild ducks very numerous.
24	55 43	72 51		E. S. E.	N. E.	N. W.	Comes in gentle breezes with light snow squalls—middle and latter part moderate—clear weather—all sails set.
25	53 36	73 36	208	N.	N.	N. E.	All this day moderate breezes with snow squalls.
26	50 57	80 33	183	S.	S.	S. W.	First and middle light, latter fine breezes—clear weather.

ABSTRACT LOG OF THE SHIP "FLYING CLOUD"—Continued.

Date.	Latitude, at noon.	Longitude, at noon.	Distance.	Winds. First Part.	Winds. Middle Part.	Winds. Latter Part.	Remarks.
1851 July 27	47°55′ S.	84°06′ W.	228	S. S. W.	S. S. W.	S. by E.	Light S. E. breezes and cloudy weather. All sail set. Sent up main-top-gallant and royal yards. Set the sails and studding sails also.
28	46 58	85 06	70	S. S. W.	W. S. W.	S. W. by W.	First part light airs and cloudy. All sail set. Middle, light rain squalls. In studding sails. Latter, set larboard studding sails. Weather fine.
29	46 06	87 46	122	Calm.	Calm.	N.	First and middle calm. Studding sails in and courses up. Latter, good breezes, fine weather, all sails set.
30	41 58	91 00	284	N. N. E.	N. N. E.	E.	Fresh breezes, with fine weather. All sails set by the wind. Latter part, wind unsteady. Ends E. S. E. Studding sails set.
31	36 58	95 46	374	S. E.	S. E.	S. E.	Fresh breezes, fine weather, all sails set. At 2 p. m. wind S. E. At 6 squally; in lower and top-gallant studding sails. 7, in royal; at 2 a. m. in fore-topmast studding sail. Latter part, strong gales, and high sea running. Ship very wet fore and aft. Distance ran this day, by observation, is 374 miles, an average of 15 and 1-14th knots per hour. During the squall 18 knots of line was not sufficient to measure the rate of speed. Top-gallant sails set.
Aug. 1	31 28	96 25	334	S. E.	S. S. E.	South.	First part, strong gales and squally. At 6 p. m. in top-gallant sails, double reefed fore and mizen topsails; bad sea running; at 4 a. m. made sail again. Ends, all larboard studding sails set; weather fine.
2	27 29	98 35	264	South	South	South.	Fresh breezes and fine weather; all sail set. Latter part moderate, and cloudy.
3	24 47	100 56	206	S. E.	E. S. E.	E. S. E.	Light breezes, fine weather. At 3 p. m. suspended first officer from duty, in consequence of his arrogating to himself the privilege of cutting up rigging, contrary to my orders, and long continued neglect of duty. Middle light squalls and cloudy weather. Latter fine.
4	21 51	102 56		E. S. E.	E. S. E.	E. S. E.	Light breezes, fine weather, and passing clouds.
5	19 12	105 31		"	"	"	" " "
6	16 24	108 08		"	"	"	" " "
7	13 34	110 53		"	"	"	" " "
8	10 42	113 42		"	"	"	" " " middle, squally, latter part fine weather.
9	7 47	116 36		"	"	"	

10	5 24	118 56		S. E. by E.	S. E. by E.	S. E. by E.	Fresh squalls with rain, ends fine.
11	2 55	121 50		E. S. E.	S. E. by E.	E. S. E.	Fine weather.
12	0 27	124 12		"	"	"	" " latter cloudy, light breezes, ends fine.
13	2 35 N.	125 20		East.	East.	East.	" " moderate breezes, and fine weather.
14	6 27	120 17		S. S. E.	S. S. E.	S. S. E.	Light breezes and squalls of rain, weather cloudy, fine at intervals.
15	9 39	127 04		"	"	"	" " fine weather.
16	12 01	127 13		S.	S.	S.	Faint " "
17	12 46	125 50		N. W.	N. W.	N. W.	Faint, fine, squally appearances in the N. W., 6 p. m., light squalls from N. W. at 8, squalls from N. E., much rain, ends calm, fine weather.
18	14 20	127 09		Calm.	N. N. E.	N. N. E.	First part cloudy, with occasional rain squalls. Middle and latter part, pleasant.
19	16 52	129 07		N. N. E.	"	"	Very light breezes and cloudy weather.
20	19 56	131 39		"	"	"	Light breezes and puffy—fine weather.
21	23 40	134 56		"	"	"	Fresh breezes and puffy—fine weather. Royals furled.
22	27 46	138 02		"	"	"	Fresh and squally, weather cloudy, reefed main top-gallant sail—set it whole again at 8 a. m. At meridian set royals, wind light.
23	31 30	140 07		N. E. by N.	N. E. by N.	N. E. by N.	Light breezes and cloudy weather, fine at intervals.
24	34 40	142 15		"	"	"	Light breezes—passing clouds.
25	35 21	141 48					Light breezes, baffling and unsteady, tacked ship six times—spoke barque "Amelia Pacquet," 180 days from London, for San Francisco.
26	36 03	141 06		N. N. E.	N. E.	E. N. E.	Light breezes, baffling and unsteady.
27	36 09	137 17		"	E. N. E.	N. E. by E.	Light breezes and cloudy weather.
28	36 36	135 00		N. by E.	N. E. by N.	N. E. by N.	Light breezes—fresh squalls with rain, tacked several times as necessary.
29	36 10	131 48		N. N. E.	N. by E.	N. N. E.	Light breezes—fine weather, lost fore-top-gallant mast.
30	36 29	127 17		N. N. W.	N. N. W.	N. N. W.	Fresh squalls, with dark passing clouds and high sea on. Sent up fore-top-gallant mast, light breezes—night strong and squally. At 2 a. m., hove the ship to for daylight, at 6 made the South Farralones bearing N. E. ½ E.: took a pilot at 7, anchored in San Francisco harbor at 11.30 a. m., after a passage of 89 days 21 hours.

By examining this abstract it will be seen that the "Flying Cloud" sailed from New York, June the 2d, 1851; went the new route; crossed the Line in the Atlantic, June 24–5, in Long. 33°; and cleared Cape St. Roque thence in two days.

She passed inside of the Falkland Islands July the 20th, and on the 24th was around the cape; having in the meanwhile, rode out a furious gale that lasted two days.

In Lat. 37° S., July 31st, she took the wind from the southward and eastward, and so carried it to Lat. 12° N. in 127° W.—having crossed the Line in the Pacific, August 12th, in 124° W.

She was a day in the "doldrums," between these two systems of trade winds. Finally she took the N. E. trades about the parallel of 14° N. in 127° W. They held on to the *North* of N. E., having forced her on the 24th as far as 142°, on the parallel of 35° N.; from which point, after fighting for 5 days with the wind from the northward and eastward—right in her teeth—she had two days of N. W. winds which she got as she neared the shore, and so ran in to the harbor of San Francisco at daylight of Sept. 1st.

For 26 days, consecutively, this ship averaged, according to her Abstract Log, two hundred and twenty-seven two-fifth nautical miles a day; her least performance for any one of these days being 93 miles, and her greatest THREE HUNDRED AND SEVENTY-FOUR; 374 nautical miles are equal to 433¼ English or statute miles; which gives the extraordinary feat of a vessel, under canvass, having averaged for 24 consecutive hours the enormous rate of $15\frac{7}{12}$ knots, or *eighteen statute miles, per hour.*

As an illustration of the extent, as to which these charts are benefitting navigators who use them and who are assisting in perfecting them, I interline the proof sheet with a letter just received from Captain J. W. Lawrence, of the American ship "Blanchard," dated San Francisco, January 7, 1853.

"SIR: Doubtless you will observe from the above abstract, that we have a very poor chance to make a quick passage with a ship of 600 tons, drawing 19 feet of water.

In regard to the passages of other ships to the line, I have met with but two ships that left about the same time that I did: the St. Peter from New York, 63 days to the equator; she did not have your charts on board; the other ship 60 days to the line. In respect to your sailing directions, I consider this abstract but a small compensation for the information derived from them."

The influence of the arid plains in the interior of North America upon the N. E. trades of the Pacific, (of which I have so often spoken) compared with the influence of the land in South America, upon the S. E. trades off its western coast, is most strikingly illustrated by the table, (p. 437.)

The distance from Valparaiso to the usual places of crossing the line in the Pacific is greater than the distance from such places to California. Yet of the 26 vessels in the table, (p. 437,) that have gone from Valparaiso to California, (and which crossed the line between 96° W. and 120° W.,) the average to the line is 22 days, and their average thence to California is 35½ days. The two shortest trips from Valparaiso to the line being 14 *days by the* "Vernon," which crossed in 119°; and 15 days by the "Angelique," which crossed in 99° W.

The shortest from the Line to San Francisco was 16 days, by the "Mary Reed," that crossed in 114°; and 26 by the "Hope," that crossed in 115°.

The longest passage from Valparaiso to the Line was by the "Mary Reed" on the same trip before quoted as one of the shortest from the Line. She had 29 days from Valparaiso to the Line, in 114°; and 16 days thence to San Francisco.

The longest passage from the Line to California by any one of these 26 vessels from Valparaiso was 50 days by the "Florence," which crossed in 106°.

The best route therefore, in August, as well as in July, September, and October, would seem to require the Line to be crossed well out to the west, to avoid the influence of the arid plains of New Mexico upon the N. E. trades. On the other hand good passages are frequently made in the Summer and Fall months by crossing near 100°—on the other extreme; for by so doing, vessels stand a chance of getting the south westerly winds which prevail between 105° and Central America at this season. A more westerly crossing, however, will be found the best in the long run.

In August the S. E. trades will often be carried as far as 10° N.; and the N. E. trades will frequently not be found until after crossing 15° N.

In September the winds will be found very much as they are in August; the shortest passage from the United States to the Line, in September, of which there are seven, was made by the "Witch of the Wave" in 90 days. She crossed in 114°, and had 25 days thence to San Francisco. The "Carioca" had 116 days from Philadelphia to 101° W., on the Equator, and 41 thence to San Francisco.

For the October crossings, we have the tracks of eleven vessels, all the way from the "States." Of these, seven crossed between 110° and 115° with an average of 99 days to the Line, and 25 days thence to San Francisco. The shortest of these eleven to the line were the clippers "Celestial," and "Sovereign of the Seas," each of 83 days to it, the former in 118° West, and 21 days thence to California; the latter having crossed in 120°, with 20 days thence. The shortest from the Line to San Francisco was 19 days by the "Typhoon," which crossed at 115°, 87 days from New York. The next shortest were the "Sovereign of the Seas" and the "Raven," clippers, each of 20 days. The Raven crossed in 112°, 85 days from New York. The next best to these, was the "Thomas Perkins," which crossed at 111°, 100 days out, and had 26 days thence into port. The clipper "Eagle" comes next in this month of good passages, 101 days out; she crossed the Line in 115° W., with 28 days thence to San Francisco.

The best crossing, therefore, for October, seems from these tracks and other statistics, to be anywhere to the west of 105° W., say between 110° and 115° W.

In December the best passage to the Line, was by the clipper "Comet," with 88 days from New York. She crossed it in 117° W., and had 16 days thence to San Francisco.

The clipper "White Squall," with 59 days from Rio, crossed in 118° and had 14 days,—the quickest run yet made—from the Line to San Francisco.

From all the information before me, I am now disposed to recommend an equatorial crossing very near long.

115°, both for November and December, provided you do not cross 50° S., to the east of 88° or 90° W. Indeed, from June to November inclusive, better winds may be expected, especially in the Northern hemisphere, far out to sea, than close in with the land. Therefore, while vessels from December to May or June, inclusive, will make better passages generally by crossing to the East of 115°; yet, for the other half of the year, they will do better by crossing rather to the West of that meridian.

The average passage of 37 clipper ships which arrived at San Francisco from the Atlantic ports of the United States between January 1, 1851, and April 1, 1852, was 124 days, the longest time being 170 days via Valparaiso, made by the "Eureka;"* and the shortest, in 89 days and 21 hours by the "Flying Cloud" direct.

The next shortest was a little over 90 days by the "Sword Fish," via Valparaiso; and the next longest was 157 days by the "Sea Nymph."

Much of the information derived from these Charts has of course been disseminated among navigators generally, as may be supposed by the fact that the average passage of clippers to California, previous to 1851, and of course previous to the general dissemination of such information, that sailed without the Charts, was 147 days.

The average of those that sailed with the Charts up to that time was 33 days less; subsequent experience has increased this difference.

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*Vide National Intelligencer, July 24, 1852.

Recapitulation of Tables, pp. 437 *to* 440.—*Showing the place of crossing the Equator in the Pacific, on the shortest passage for each month.*

NAME.	To Line in Pacific.	Place of crossing.	Line to Califor'a.	Total Passage from Atlantic Ports to California.	
	Days.		Days.	Days.	Crossed the Line in the Month of
Flying Fish,	77	120° W.	23	100	January.
Sword Fish,	71	110	20	91	"
Celestial,	84	113	23	107	"
Wild Pigeon,	88	109	17	105	"
Golden Gate,	90	106	23	113	"
Seaman,	89	118	18	107	February.
Hazard,	107	109	24	133	"
Helena,	113	110	18	131	"
Surprise,	80	110	17	97	March.
Samuel Appleton,	103	110	18	121	"
Samuel Russell,	90	118	20	110	April.
Russell Glover,	115	113	21	136	"
Stag Hound,	93	114	21	114	May.
Stag Hound,	90	96	34	124	"
Tornado,	84	107	44	128	"
Sea Serpent,	88	101	25	113	June.
Wild Pigeon,	89	109	18	107	"
Governor Morton,	91	102	32	134	"
Staffordshire,	83	108	18	101	July.
Cohota,	103	110	23	126	"
Empire,	97	102	35	132	"
Thomas B. Wales,	100	103	33	133	"
Flying Cloud,	71	124	19	90	August.
N. B. Palmer,	88	114	19	107	"
Union,	91	101	28	119	"
Witch of the Wave,	90	114	25	114	September.
Templeton,	123	112	27	150	"
Sovereign of the Seas,	83	120	20	103	October.
Raven,	85	112	20	105	"
Celestial,	83	115	21	104	"
Typhoon,	87	115	19	106	"
Sea Witch,	91	114	17	108	November.
Winged Arrow,	95	115	22	117	"
Raven,	93	105	29	122	"
Comet,	88	117	16	104	December.
White Squall,	From Rio.	124	14		"

It is much to be regretted that I have not materials enough to give averages that will afford the means of a just comparison as to the relative advantages of each crossing in the several months.

A proper discussion of the best routes to California for the different seasons, involves something more than a knowledge of the best place to cross the Line in the Pacific, and of the best way thence to San Francisco. We want to know the best way of getting to the Line, as well as the best route from it. We know quite accurately the best route from the United States to Cape Horn; and with the view of showing navigators the best route, on the long run, from Cape Horn to California, I have prepared the table below, showing the day and meridian on which the vessels therein named crossed the parallel of 50° S., and afterwards the equator. Also the longitude at which they crossed the parallels of 40° S., 35°, 30°, and 25°, concluding that by the time they reach this last named parallel, they will be in the regular S. E. trades.

I have then taken the mean of the best passages for each month to show the best crossing on the average for each of the southern parallels named. This table cannot fail to be most acceptable and useful to every California bound vessel.

CALIFORNIA ROUTES FROM 50° S. TO THE EQUATOR.

Name.	Date of Crossing Parallel of 50° S.	Longitude of Crossing the Parallels of 50° S.		40° S.		35° S.		30° S.		25° S.		Long. of Crossing the Equator.		Date of Crossing the Equator.	Days from 50° S. to the Equator.	Days from the Equator to San Francisco.
	January.	°	'	°	'	°	'	°	'	°	'	°	'		Days.	Days.
Hazard	23, '51	77	0	81	0	83	0	84	0	86	0	109	0	Feb. 21, '51	24	24
Helena	28, '51	78	0	83	0	87	0	91	0	94	0	110	0	19, '51	22	21
Russell	8, '50	83	0	83	0	84	0	85	0	89	0	110	0	7, '50	30	37
Cygnet	27, '50	84	0	83	0	79	0	81	0	87	0	111	0	26, '50	30	29
R. C. Winthrop .	31, '51	82	0	86	0	87	0	90	0	92	0	110	0	March 3, '51	31	29
Potomac	31, '51	80	0	79	0	79	0	83	0	88	0	111	0	3, '51	31	32
Sword Fish . . .	2, '52	80	0	90	0	94	0	95	0	98	0	110	0	Jan. 21, '52	19	20
Seaman	28, '51	79	0	83	0	88	0	92	0	97	0	118	0	Feb. 20, '51	23	18
Acasta	31, '51	82	0	86	0	87	0	91	0	92	0	121	0	March 10, '51	38	28
Mean of the four best	. . .	78	0	84	0	88	0	90	0	94	0	112	0	. . . . . .	22	21
	February.															
Whiton	16, '47	80	0	77	0	79	0	80	0	82	0	93	0	March 13, '47	25	42
Geo Brown . . .	13, '51	80	0	86	0	88	0	89	0	91	0	105	0	14, '51	29	22
Whiton	11, '49	84	0	76	0	74	0	78	0	87	0	109	0	15, '49	32	28
Samuel Appleton .	26, '51	79	0	83	0	88	0	90	0	93	0	109	0	23, '51	25	18
Uriel	28, '51	78	0	82	0	85	0	86	0	90	0	110	0	30, '51	30	34
Surprise	8, '51	79	0	82	0	83	0	86	0	88	0	110	0	3, '51	23	17
Hannibal . . .	23, '50	95	0	84	0	89	0	93	0	98	0	115	0	22, '50	27	29
Southerner . . .	27, '51	80	0	85	0	90	0	87	0	88	0	117	0	30, '51	31	28
Newton	4, '51	81	0	80	0	79	0	79	0	85	0	117	0	10, '51	34	26
Canton	28, '50	35	0	88	0	89	0	94	0	97	0	118	0	28, '50	28	29
Lucia Field . . .	5, '51	78	0	83	0	87	0	91	0	95	0	119	0	19, '51	42	31
Europe	17, '52	80	0	78	0	76	0	77	0	81	0	100	0	17, '52	28	35
Mean of the four best	. . .	81	0	84	0	87	0	89	0	92	0	113	0	. . . . . .	26	21½
	March.															
Hurricane . . .	4, '52	81	0	80	0	82	0	85	0	88	0	103	0	March 22, '52	18	24
Great Britain . .	25, '52	79	0	81	0	74	0	74	0	78	0	104	0	April 28, '52	34	30
Sartelle	2, '50	79	0	80	0	80	0	82	0	85	0	109	0	March 28, '50	26	34
Howard	5, '52	80	0	80	0	80	0	83	0	88	0	110	0	29, '52	24	25
Wisconsin . . .	27, '52	84	0	83	0	78	0	78	0	82	0	106	0	April 22, '52	26	30
Hermann . . .	27, '50	81	0	76	0	76	0	82	0	87	0	109	0	May 11, '50	45	37
Daniel	26, '51	77	0	78	0	77	0	82	0	87	0	113	0	April 28, '51	33	33
Isette	5, '50	84	0	87	0	88	0	90	0	92	0	110	0	May 10, '50	66	37
Stag Hound . . .	30, '51	79	0	77	0	74	0	75	0	81	0	113	0	4, '51	34	21
Isabelita Hyne . .	26, '51	83	0	81	0	83	0	84	0	88	0	116	0	April 23, '51	28	24
Maria	14, '51	78	0	77	0	78	0	82	0	85	0	117	0	16, '51	33	32
Samuel Russell .	17, '50	84	0	83	0	82	0	81	0	84	0	119	0	15, '50	29	20
Mean of the best six	. . .	82	0	81	0	81	0	81	0	85	0	110	0	. . . . . .	25	26

TABLE—*Continued.*

Name.	Date of Crossing Parallel of 50° S.	Longitude of Crossing the Parallels of— 50° S.	40° S.	35° S.	30° S.	25° S.	Long. of Crossing the Equator.	Date of Crossing the Equator.	Days from 50° S. to the Equator.	Days from the Equator to San Francisco.
	April.	° ′	° ′	° ′	° ′	° ′	° ′		Days.	Days.
Ocean Bird . . .	17, '49	81 0	76 0	78 0	79 0	78 0	99 0	May 23, '49	36	38
Anonyma . . .	25, '49	78 0	78 0	82 0	86 0	87 0	103 0	23, '49	28	34
Aurora	18, '49	81 0	79 0	73 0	75 0	75 0	110 0	30, '49	42	31
New Castle . . .	28, '49	79 0	78 0	74 0	77 0	80 0	109 0	June 11, '49	44	54
F. Depau . . .	4, '50	78 0	77 0	73 0	74 0	81 0	113 0	May 20, '50	46	27
Diadem	7, '50	81 0	74 0	74 0	89 0	82 0	116 0	22, '50	45	36
Tornado	24, '52	83 0	80 0	81 0	85 0	88 0	108 0	18, '52	24	44
Mean of the two best	. . .	80 30	79 0	81 30	85 30	87 30	105 0	. . . . . .	26	37
	May.									
Sweden	29, '49	80 0	88 0	89 0	90 0	84 0	102 0	June 26, '49	28	38
Sherwood . . .	30, '51	81 0	86 0	89 0	91 0	97 0	109 0	25, '51	26	40
Ino	24, '51	78 0	81 0	82 0	79 0	82 0	109 0	19, '51	26	34
Edgar	29, '50	78 0	77 0	73 0	73 0	78 0	108 0	July 2, '50	34	39
Henry Pratt . . .	1, '50	79 0	80 0	78 0	79 0	84 0	110 0	June 7, '50	37	41
Archibald Gracie .	7, '50	83 0	86 0	85 0	85 0	87 0	111 0	11, '50	35	36
Delia	6, '51	87 0	91 0	87 0	84 0	85 0	114 0	10, '51	35	34
Arcole	5, '51	84 0	98 0	99 0	100 0	102 0	117 0	May 31, '50	26	30
Kensington . . .	3, '50	81 0	88 0	88 0	89 0	90 0	123 0	June 24, '51	52	39
Sea Serpent . . .	8, '52	79 0	78 0	79 0	76 0	76 0	102 0	6, '52	29	24
Stag Hound . . .	9, '52	82 0	88 0	88 0	85 0	81 0	100 0	1, '52	2[illegible]	32
Michael Angelo .	31, '52	86 0	85 0	83 0	82 0	86 0	102 0	27, '52	27	35
Rose Standish . .	19, '50	78 0	81 0	80 0	81 0	87 0	113 0	20, '50	32	44
Mean of the best four	. . .	81 0	86 0	87 0	85 0	85 0	107 0	. . . . . .	26	35
	June.									
Gazelle	7, '49	80 0	80 0	80 0	82 0	84 0	106 0	July 9, '49	32	30
Clarissa Perkins .	24, '49	78 0	82 0	81 0	81 0	83 0	114 0	30, '49	36	43
Venice	6, '50	80 0	80 0	79 0	80 0	80 0	115 0	14, '50	38	30
Sarah and Eliza .	26, '49	82 0	81 0	76 0	76 0	85 0	114 0	Aug. 12, '49	47	36
Columbia* . . .	15, '50	79 0	81 0	80 0	81 0	82 0	112 0	Oct. 12, '50	*	35
Raduga	26, '51	81 0	80 0	78 0	78 0	76 0	118 0	July 28, '51	32	25
Sheridan	1, '50	80 0	84 0	90 0	92 0	90 0	118 0	2, '50	31	28
Tartar	29, '51	82 0	85 0	86 0	91 0	95 0	122 0	24, '51	25	30
T. B. Wales . .	3, '52	81 0	83 0	83 0	8[illegible] 0	90 0	103 0	3, '52	30	33
Louisa Bliss . .	1, '50	79 0	75 0	72 0	74 0	77 0	99 0	8, '50	37	52
Empire	5, '52	78 0	88 0	93 0	95 0	99 0	102 0	8, '52	33	36
Cohota	23, '50	84 0	89 0	91 0	96 0	95 0	110 0	19, '50	26	23
Mean of the six best	. . .	81 0	83 0	83 0	86 0	87 0	111 [illegible]	. . . . . .	30	32

* Touched at Juan Fernandez.

TABLE—*Continued.*

Name.	Date of crossing Parallel of 50° S.	Longitude of crossing the Parallels of— 50° S. °	'	40° S. °	'	35° S. °	'	30° S. °	'	25° S. °	'	Longitude of crossing the Equator. °	'	Date of crossing the Equator.		Days from 50° S. to the Equator.	Days from the Equator to San Francisco.
	July.															Days.	Days.
St. Patrick . . .	19, '50	81	0	90	0	92	0	93	0	95	0	115	0	Aug.	14, '50	26	30
Isaac Allerton . .	17, '50	81	0	93	0	96	0	97	0	99	0	111	0		13, '50	27	34
Caroline	15, '50	81	0	82	0	86	0	88	0	93	0	113	0		11, '50	27	34
N. B. Palmer . .	10, '51	86	0	88	0	89	0	91	0	93	0	114	0		2, '51	22	19
Witch of the Wave	27, '51	83	0	85	0	86	0	87	0	88	0	115	0		18, '51	22	32
Finland	2, '50	89	0	104	0	106	0	108	0	114	0	117	0		6, '50	35	42
Flying Cloud . .	26, '51	81	0	90	0	94	0	96	0	101	0	124	0		12, '51	17	19
Staffordshire . .	8, '52	79	0	85	0	86	0	87	0	94	0	110	0		25, '52	48	18
Mean of the best six	. . .	82	0	88	0	90	0	92	0	95	0	115	0			23	28
	August.																
Chatham	22, '49	78	0	78	0	78	0	80	0	81	0	99	0	Sept.	22, '49	31	39
Templeton . . .	11, '50	84	0	87	0	86	0	90	0	91	0	113	0		10, '50	30	27
Lady Arabella . .	5, '50	83	0	83	0	81	0	86	0	93	0	113	0		4, '50	30	33
Virginia	5, '50	84	0	90	0	93	0	96	0	100	0	113	0		2, '50	28	33
Copeland . . .	16, '52	87	0	87	0	88	0	89	0	91	0	104	0		7, '52	22	39
Carioca	10, '52	84	0	85	0	87	0	86	0	88	0	101	0		6, '52	27	41
Union	10, '52	84	0	85	0	85	0	87	0	88	0	101	0	Aug.	31, '52	21	28
Mean of the five best	. . .	85	0	87	0	88	0	90	0	92	0	106	0			26	32
	September.																
Angelique . . .	25, '49	79	0	79	0	74	0	75	0	78	0	99	0	Oct.	29, '49	34	44
Mermaid	2, '51	80	0	85	0	87	0	88	0	91	0	106	0	Sept.	21, '51	19	27
Telegraph . . .	27, '51	81	0	82	0	82	0	81	0	84	0	110	0	Oct.	22, '51	25	23
Celestial	24, '50	84	0	90	0	90	0	91	0	96	0	115	0		11, '50	18	20
Thomas Perkins .	29, '49	79	0	78	0	77	0	80	0	86	0	111	0		25, '49	26	26
Eagle	28, '51	85	0	88	0	89	0	90	0	90	0	115	0		20, '51	22	28
Carrington . . .	13, '50	83	0	88	0	88	0	88	0	90	0	115	0		5, '50	22	26
Gertrude	16, '50	83	0	90	0	93	0	95	0	100	0	116	0		8, '50	22	30
Mean of the four best	. . .	82	0	86	0	87	0	87	0	90	0	111	0			21	24
	October.																
Sea Witch . . .	5, '51	79	0	84	0	86	0	85	0	86	0	101	0	Oct.	27, '51	22	23
Boston	23, '49	80	0	78	0	75	0	74	0	78	0	106	0	Nov.	27, '49	31	40
Raven	5, '51	79	0	81	0	84	0	85	0	85	0	112	0	Oct.	29, '51	24	20
Talbot	13, '50	82	0	82	0	83	0	85	0	88	0	115	0	Nov.	12, '50	29	31
Valparaiso . . .	1, '51	84	0	83	0	86	0	86	0	91	0	115	0		2, '51	32	30
Mean of the three best	. . .	80	0	82	0	84	0	85	0	86	0	109	0			25	25
	November.																
Horton	11, '50	80	0	78	0	75	0	80	0	86	0	109	0	Dec.	23, '50	42	33
Comet	28, '51	84	0	90	0	89	0	92	0	94	0	117	0		28, '51	30	16

TABLE—*Continued.*

Name.	Date of crossing Parallel of 50° S.	Longitude of crossing the Parallels of— 50° S.	40° S.	35° S.	30° S.	25° S.	Longitude of crossing the Equator.	Date of crossing the Equator.	Days from 50° S to the Equator.	Days from the Equator to San Francisco.
	December.	° ′	° ′	° ′	° ′	° ′	° ′		Days.	Days.
Golden Gate . .	20, '51	83 0	82 0	82 0	82 0	85 0	106 0	Jan. 12, '52	23	23
John Jay . . .	30, '49	79 0	78 0	74 0	74 0	78 0	105 0	Feb. 6, '50	37	37
Wild Pigeon . .	20, '52	85 0	84 0	84 0	85 0	86 0	109 0	Jan. 10, '52	31	18
Ambassador. . .	19, '49	78 0	78 0	81 0	85 0	87 0	113 0	Feb. 26, '50	38	32
Tigress	2, '50	82 0	80 0	80 0	81 0	85 0	114 0	June 1, '50	*	33
Flying Fish . . .	31, '51	79 0	79 0	83 0	89 0	93 0	120 0	Jan. 22, '52	22	23
White Squall . .	1, '50	81 0	80 0	79 0	82 0	83 0	118 0	Dec. 24, '50	23	14
Mean of the four best	. . .	82 0	81 0	82 0	84 30	87 0	119 0		25	19½

This table is very suggestive. With the view of pointing out the shortest route from 50° S. to the line, in the fair way to California, I have selected from the tables already presented, the monthly mean of the best passages for each month; I have tabulated also the monthly mean longitude in which the vessels making these mean passages crossed the parallels named, including the Equator.

From this selection it appears to be indicated that the farther west you cross the parallel of 35° S., the quicker will be the passage, *on the average*, as the following summary of averages taken from the last table goes to show.

MONTHLY MEAN OF BEST PASSAGES.

Month.	Mean of the best.	Best Longitude for Crossing the Parallels of— 50° S.	40° S.	35° S.	30° S.	25° S.	0.	From 50° S. to 0°.	From 0° to San Francisco.
		° ′	° ′	° ′	° ′	° ′	° ′	Days.	Days.
January .	4	78 0	84 0	88 0	90 0	94 0	112 0	22	21
February	4	81 0	84 0	87 0	89 0	92 0	113 0	26	21½
March .	6	82 0	81 0	81 0	81 0	85 0	110 0	25	26
April . .	2	80 0	79 0	82 0	86 0	85 0	105 0	26	37
May . .	4	81 0	86 0	87 0	85 0	85 0	107 0	26	35
June . .	6	81 0	83 0	83 0	86 0	87 0	111 0	30	32
July . .	6	82 0	88 0	90 0	92 0	95 0	115 0	23	28
August .	5	85 0	87 0	88 0	92 0	92 0	106 0	26	36
September	4	82 0	86 0	87 0	87 0	90 0	111 0	21	24
October .	3	80 0	82 0	84 0	85 0	86 0	109 0	25	25
December	2	82 0	81 0	82 0	84 0	87 0	119 0	25	19½

The average monthly crossing of 35° S., by the mean of the four quickest runs in each of the months of January, February, May and September; of the six best in February; and of the five best in August, was, it will be perceived from the above, as far West, all of them, as 87°. The crossings for the other months were East of this. Now, for convenience, let us call the former the western crossings. The mean passage for

these six months is 24 days from 50° S., to the Line; whereas the mean passage for the others, or by the eastern crossings is 26 days.

So too with the parallel of 25° S.: those crossings which were as far West as 90° on this parallel, all show better runs than do those to the East of it. The five of the first named months that fall within the category of this last crossing, give a run of 23 days from 50° S. to the Equator, against 26 days by the six of the latter. The July crossings of 25° S., (mean of six) are the most westerly; they are in 95°, and give a mean run of 23 days from 50° S. to the Line. The next crossings to the West are the January—mean of 4 in 94°; they give 22 days as the mean run from 50° S. to the Equator.

In urging upon California bound vessels the importance of making westing about the parallel of 50° S., I do not mean that they should expose themselves to heavy weather or contend against adverse circumstances in order to get West on this part of the route; I simply mean that, if a vessel, after doubling the Cape can steer a W. N. W. course as well as a N. W.; or a N. W. as well as N. N. W.; or a N. N. W. as well as a N. course; that she should on all such occasions give preference to the course that has most westing in it, provided she do not cross 50° S. to the westward of 100° or thereabouts; nor 30° S. to the westward of 120°; nor enter the S. E. trade wind region to the West of the last named meridian. This is the western route. It is so called because it requires you to keep as far West within certain limits, as well you may without running broad off to make westing, or without fighting with head winds, or baffling winds, or calms, to get West.

The western route from Cape Horn to California is to be preferred by all vessels that double the "Horn" from May till October inclusive. This route lies well out from the land; so that the influence of the land upon the winds will not be as marked as it is at the same season along the eastern or usual route.

The farther from the land, the more regular and steady the wind, may be safely taken as a general rule.

There is much more land in the northern than in the southern hemisphere—and the action of the Sun's rays in our summer time upon this excess of the land, very materially interferes, as my researches abundantly prove, with the regular course of the N. E. trades.

Where is there such a thing known as a regular monsoon in the Southern Hemisphere? The monsoons of India and the China seas are due this excess of land in our hemisphere. So are the African monsoons of the Atlantic, the monsoons of the Pacific, and those of the Gulf of Mexico. They are all produced by the action of the rays of the sun upon extensive deserts, or wide and arid plains in the Southern Hemisphere. There may be a monsoon about New Holland, but we are speaking of what we know certainly to be the case.

In the interior of North America, between the parallels of 30° and 40° N., there is an immense region of country that is parched with drought during the summer and fall; the influence of this region is as I have before remarked, felt by the winds of the Gulf of Mexico, by the winds of the intertropical regions of the Pacific beyond Central America, and by the winds out upon the high seas, off the coast of California and Oregon;—these winds for many miles out to sea feel that influence, obey it, and assume the character more or less of monsoons during our summer and fall.

In the discovery of this fact we have the key to the California route, from the equator up.

A vessel that crosses the Equator in August or September as far as 120° or 125° W., is some 1500 miles fron the Continent, and about 2500 miles from the centre of this disturbing agent. Being bound from the crossing to California, she has the belt of N. E. trades to cross. These winds blow with much more regularity to the West of 120° than they do at this season in with the coast. Having, therefore, to cross them the vessel is enabled to do it by a course on the average, between N. N. W. and N. W. This course brings her out of them as far West, it may be, as 145°, about the latitude of San Francisco. But this is the season when N. W. and westerly winds most prevail in this part of the ocean also.

On account of the atmospherical disturbance situated in the interior of North America, as before explained, and in the latitude of San Francisco, or as high up as 40°, (for that will be found occasionally not too far for a vessel in the western route to go) the degrees of longitude are not long, and with fair winds it will not take many days for her, when near the parallel of 40°, to run down 10° or 15° of longitude.

Therefore, California bound vessels crossing the parallel of 50° S., from May to October, should bear to the West, while in the southern hemisphere.

Let the navigator draw on his chart two lines from the parallel of 50° S. to the Equator, viz: one from Long. 100° W., Lat. 50° S., to Long. 130° W., Lat. 0; the other from Long. 80° W., Lat. 50° S., to Long. 115° W., Lat. 0; and if the season of the year be any where between May and October when he is on this part of the route, let him aim to keep between these two lines as in a lane. He will not often be able to get as far West as 90°, before crossing the parallel of 50° S., but he should endeavor to cross it as far West—provided he does not go farther than 100° W.—as the winds will allow.

During the rest of the year the best passage on the average will be made by letting the more easterly of these two lines be the western limit; that is, the navigator need not care, when doubling Cape Horn between November and April inclusive, to go much West of the line that I have recommended to be drawn from 50° S., in Long. 80° W., to the Equator in Long. 115° W. If one be forced at this season to cross 50° S., as far West as 90°, he will not infer, therefore, that he is to be thereby a loser of time: by no means. What I want to impress upon those who take these Sailing Directions for their guide, is that there is no advantage to be gained by the sacrifice of a week, or a day in the winter and spring, for the sake of crossing the equator or any other given parallel a degree or two, or even five degrees more to the eastward or westward of the meridian, recommended. It will therefore be understood that 85° is not too far West to cross the parallel of 50° S., even for the eastern passage, provided winds favor that crossing.

There are no monsoons here in winter and spring, therefore vessels need not fear to cross the Equator pretty well to the eastward of the summer and fall crossing; and for this reason: In the winter and spring, the monsoons are not raging; the N. E. trade winds are pretty steady even in the vicinity of the coast, and the course through them to California is northwesterly. After one has passed through these winds at this season, the "Horse Latitude" calms of the Pacific are often found troublesome; therefore, to avoid them as much as possible, the California bound trader wants to be as near his port as practicable, when he loses the N. E. trades

in winter and spring. This he can best do by crossing the equator in 105° or 110°, running through the N. E. trades, with topmast studdings set, and aiming not to go, if he can help it, more than a degree or two West of his port, say not further West of the meridian of 130°, than can be avoided.

According to all these California passages, and the results which they show, it appears that it is *possible* for a vessel under canvass to make the run from New York to San Francisco in 85 days. And it does not appear that there has ever been a combination of circumstances, and a succession of winds which would have made it possible for any vessel to have done this more than once or twice in the last three years. If the "Flying Cloud," or the "Sword Fish," after crossing the line in the Pacific had met with the winds which the "White Squall" had thence to San Francisco, she would have made the run in 85 days. Eighty-five days may be regarded, therefore, as the shortest "combined" passage, and as the minimum limit of *possible* passages from any one of the Atlantic ports of the United States. It is therefore, we may infer, within the range of probability, that the passage by ships at their present rate of speed, may be made in 85 days from the Eastern States to California; but it is scarcely probable, for it is barely within the range of possibility, that it will ever be made in less time.

The Farallones, seven small islands, about 30 miles from San Francisco, are in the fair way to the harbor. They afford a fine land-mark, and should be made by all inward-bound vessels. The course from the South Farallone to the mouth of the harbor is about N. 73° E., *true*, distance 27 miles; or by compass N. E. by E. ¼ E. "The Fort on with the south point of the island of Alcatraces," is said to be the best course in.*

Vessels upon approaching "The Heads" of San Francisco, especially in the winter months are liable to be beset by fogs. I have reports of some vessels that have had fine runs all the way from the United States; and yet when they got almost in sight of the port have been enveloped with and delayed by fogs for many days.

The positions of the following named points or places along the coast of California have been determined by the Coast Survey: They differ somewhat from the Wind and Current Charts, I therefore quote them in this place.

	° ′ ″	° ′ ″
San Clemente (S. E. end of Island of San Clemente)	33 00 00 N.,	118 34 00 W.
San Nicholas (S. E. end of Island of San Nicholas)	33 14 12 N.,	119 25 00 W.
San Luis Obispo (Bay of San Luis Obispo)	35 10 37 N.,	120 43 31 W.
San Simeon (Bay of San Simeon)	35 38 24 N.,	121 10 22 W.
† Point Pinos (Bay of Monterey)	36 37 59 N.,	122 00 10 W.
Prisoner's Harbor (Island of San Miguel)	34 01 10 N.,	119 40 00 W.
Cuyler's Harbor (Island of San Miguel)	34 00 00 N.,	120 20 27 W.

* See Sailing Directions by Capt. Cadwallader Ringgold, U. S. N., 1851.

† The only place named on the Charts. The others are small towns and harbors the names of which are not on the Wind and Current Charts, though the places for them are.

The object of these charts should not be forgotten by navigators. They are intended to illustrate the winds and currents; to show the tracks of vessels at sea, and to serve the practical purposes of the navigator until he reaches the land, when it is presumed he will be guided by Pilots or local Charts, and not by the track charts for running into port.

Australian Routes.

The gold ports of Australia, whether the distance be measured via Cape Horn, or by the way of the Cape of Good Hope, are between 12,000 and 13,000 miles from the Atlantic ports of the United States. The best way for vessels in the Australian trade, from Europe or America via the Atlantic, to *go*, is by doubling the Cape of Good Hope; and the best way to *come* is, via Cape Horn; and for this reason, viz: The prevailing winds in the extra-tropical regions of the Southern Hemisphere are from the N. W., which of course makes fair winds for the outward bound around the Cape of Good Hope, and fair winds for the homeward bound around Cape Horn. Here all is plain sailing; vessels homeward bound should steer straight for Cape Horn, and the outward bound, after doubling the Cape of Good Hope, should shape their course as direct for the port of destination, as the land and the winds will permit them.

Returning by the way of Cape Horn homeward, the best route is to get south of the parallel of 40° as soon as you can, and then shape the course direct for Cape Horn, recollecting that the further you keep south of the middle of the straight line on your chart from Van Dieman's land to Cape Horn, the nearer you are to the Great Circle route, and the shorter the distance. The difference by the Great Circle, and by the straight course on the charts, being upwards of 1,000 miles.

In the passage from Australia to Cape Horn, by keeping between the parallels of 40° and 60° all the way, you will, I am of the opinion, feel more or less, the warmth and set of a current that passes south of Australia from the Indian Ocean. Whether the boisterous weather to which a warm current in such latitudes would give rise, will compensate for the advantages to be gained in other respects, must be left for experience to determine. For my own part, I do not suppose this current to be as strongly marked as is our Gulf stream in the Atlantic; though the passage from the Capes of the Delaware to Liverpool may be considered as affording us the means of judging pretty accurately as to this passage from Australia—the chief difference being, I suppose, in the climate and the gales.

The climate in the Pacific along this route will be found not quite so mild as is that along the European route in the Atlantic. But the gales in the Atlantic are probably more frequent and violent than they are in the South Pacific—at any rate I suppose that such will be found to be the case, until you reach the regions of Cape Horn.

The Australian routes present occasional opportunities for fine runs. In the South Pacific Ocean, below the parallel of 35° or 40° S. and away from the influence of the land—as along this route, especially from New Zealand to Cape Horn—the westerly winds blow almost with the regularity of the trades; and a fast vessel taking a westerly gale as she clears the New Zealand Islands, may now and then run along with it pretty nearly to Cape Horn, or taking it on the outward passage after clearing the Cape of Good Hope—by keeping well south—may run along with it to Van Dieman's land.

The great circle distance from South Australia to California is about 7,000 miles, and vessels in the direct trade between Australia and the Pacific coasts of the United States may have the choice of routes going as well

as coming—going the distance to be sailed on account of detour for the sake of winds, is about 7,500 miles. returning, that is, coming this way by the eastern route, the distance is eight or nine hundred miles greater. With the exception of the N. E. trades on the passage from New South Wales, or Victoria to California, the winds are fair or may conveniently be made fair both ways. A N. E. course good can be made through the S. E. trades; and a N. N. W. course on the average through the N. E. trades. But these courses will not give easting enough for the California bound trader, and it therefore becomes a question for him to decide whether he will make up his easting in the variables south of S. E. trades, or in the variables N. of the N. E. trades, for in both of those systems of variables westwardly winds prevail.

In coming out of the Victoria ports, go south of Van Dieman's Land, or through Bass' straits, as you have the winds and find it expedient.

Being south of Van Dieman's Land makes it convenient to pass south of New Zealand, if the wind be fair, as in the majority of cases it will be. Having passed south of New Zealand, steer for the parallel of 40° S., at or near its intersection with the meridian of 150° W., thence for the equator between 120° and 130° W., crossing by a north course, both the horse latitudes of the Southern Hemisphere and the equatorial dol drums; then run through the N. E. trades as best you may, keeping a "rap full" and running up into the variables beyond the horse latitude calms of the Northern Hemisphere, if need be, to complete your easting and make your port.

If the winds be not fair for passing south of New Zealand, try Cook's straits in preference to passing to the north of New Ulster.

If you pass through Cook's straits, then stick her well to the eastward and take the eastern passage. On this passage you should run down your easting pretty well before you get far enough north to be bothered by the baffling winds of the horse latitudes south. If these come as low down as 38° or 40° S., stand north the moment you feel them till you get the S. E. trades; then cross these and the N. E. trades, both as obliquely to the eastward as they will permit, with fore-topmast studding-sails set.

On this passage you will have finally to run down your easting, when you get into the variables, beyond the N. E. trades, and of course you will aim to reach the parallel of 38° or 40° N., or even a higher one north, to do this. How far you will go north depends somewhat upon the distance you may be west of California when you lose the N. E. trades. If you be only a degree or two from the land, you will steer straight for your port without caring to get to the northward of it; but if you be ten or twenty degrees to the west of it, or even farther, then of course the distance to be run makes it an object to turn out of your way and go north in search of good winds.

Therefore the choice of routes on this voyage resolves itself into the answer to this question: Is it best to make easting between the parallels of 40° and 50° S., or about the parallel of 40° N.? If the former, then the eastern route is the route; if the latter, then the preference should be given to the western route.

I give preference to the eastern route especially and decidedly when the winds at starting are favorable for the east course. I have no doubt but that, as a general rule, the winds by the eastern route, both variables

and S. E. trades, are much more steady and reliable than they are by the western route. Moreover, the distance from the Victoria ports, *via* south side of Van Dieman's Land and New Zealand, is not more than three or four hundred miles greater than it is by the most direct route that is practicable, and the chances of good winds, by the eastern route, will, in my opinion, amply make up for this increased distance.

It is proper for me to state here that I do not give these Australian sailing directions as directions that are founded on or derived from investigations into the routes actually pursued by vessels from Australia to California; but I give them as deductions drawn from the knowledge which I have acquired touching the general system of the winds and currents out upon the high seas.

The most difficult and uncertain parts of this passage will be in the time required to cross the three belts of calms, and to clear the winter fogs of California. But for these, the Eastern passage, from Victoria to California, would be one of the most certain passages in the world.

The distance from Victoria to California cannot be accomplished under canvass, by the Eastern route, much short of 8,700 miles. But driving Captains, with clipper ships under them, along this route, may expect to average one trip with another, not far from 200 miles per day. The clipper rate from Victoria to Cape Horn, will probably be upwards of 200 miles a day; for I feel assured there is no part of the ocean in which the winds generally will admit of more heavy dragging and constant driving than they will in the extra-tropical regions generally of the South Pacific, say on the polar side of 40° S.

Returning from California to the gold fields of Australia, the route out of San Francisco, should be down as soon as possible into the N. E. trades, as though you were bound to China, India, or the Sandwich Islands, crossing the equator any where between the meridians of 140° and 150° West, according as you prefer to run down your Westing, principally in the N. E. or S. E. trades. I give the preference to the latter generally, because they are more steady, reliable and certain than are their congeners of the Northern Hemisphere—at least such is the rule. The distance by this route to Bass' Straits will be about 7,500 miles, and an increase upon this of the average distance to be sailed on the passage going, together with the distance returning, will not amount, as before stated, to more than six or eight hundred miles.

Aim to cross 30° S. on the passage from California to Australia, in the neighborhood of 170° E.

Thence, the course is between Australia and New Zealand direct for your port.

In these passages as on the California routes generally, navigators have to cross the calms of Cancer and of Capricorn, as well as those of the equator; which last are found between the N. E. and S. E. trade winds, but upon different parallels, according to the season of the year.

It may, therefore, be remarked, here once for all, and which remark navigators bound either from the U. States or from Panama to California, are requested to bear in mind, that the barometer will often enable the navigator to tell when he has crossed these belts of calms, and entered the trades.

In the belt of equatorial calms there is an ascending column of air. All the atmosphere which the N. E. and S. E. trades pour into this belt, rises up and flows off by counter currents in the upper regions. Of course, then, the mean height of the barometer in the equatorial calms, is less than its mean height in the

trades on either side. This difference does not, probably, exceed one tenth of an inch (0.1 inch.) But close attention to the barometer in and about these calms, will often enable the navigator to decide whether the winds he may have be really trade winds or not; for after having been fighting these calms, if you get the wind from N. E. or S. E., as the case may be, and the barometer *rises*, then you may be sure that you have the trades.

I have frequently, in the course of this work, had occasion to allude to the equatorial calms and the rains which accompany them. In this day it is not sufficient to tell the navigator that things are so. He depends more upon the lights of reason and the convictions of his understanding, less upon faith and the *ipse dixit* of philosophers than he used to do. And therefore, when facts and phenomena are now stated to him, his first question generally is, for the explanation of them. I admire this spirit, and have frequently, in the pages of this work, as I do now, turned aside to pay homage to it.

Where the two trade winds meet, they and the vapors which they bring ascend, and it is then "the rainy season."

I have been permitted to copy from the meteorological journal, kept for several years at Para, near the mouth of the great river Amazon, by Mr. Dewey, an intelligent American merchant, which serves beautifully to illustrate and to explain the phenomena of these rains in the equatorial calms.

I quote tables which I have had compiled from these observations, together with Dewey's description of Para, that the navigator, by studying them, may the better understand the remarks I have made and those I have to offer.

From Dewey's Meteorological Journal kept at Para from 1845, *to June*, 1849.

" Latitude of the city of " Santa Maria de Belem do Gram-Para," south 1° 28′; Longitude from Greenwich, west 48° 29′. Situated about 80 miles from the ocean, on the southern mouth of the river "Amazonas;" this mouth of the river being commonly called the " Para" river, but strictly a part of the great Amazon. The breadth of the river at the city is about nine miles; and it is studded with innumerable islands; the nearest of which, called " Ilha das Onas," directly opposite the city, is distant from it three miles. These islands form a magnificent basin which is the harbor of Para. Great changes are constantly occurring in the river, old shoals being washed way and new ones formed. A few years since, there existed an Island, a few miles below the city, called " Parroquet" Island—this has gone, and vessels of the largest burden can pass over the spot where it once stood; but, on the other side of the channel where vessels formerly passed, has, within a few years appeared a large island, already covered with trees of no small size, called " Ilha Nova." The tide rises here about eleven feet. The country in this region is low and covered with magnificent forests—indeed, the entire province may be said to be an almost unbroken forest, with underwood of such density as to render a passage utterly impossible, except by the foot-paths of the natives. The birds of this region are of great beauty, and for an Ornithologist, this province presents a field of unrivalled richness.

The water of the springs is unsurpassed by any in the world; and that of the river is always perfectly fresh except at high spring tides, when it becomes rather brackish. The water of the river is exceedingly muddy, but at low tide, springs of water as pure as chrystal may be seen gushing from the sands.

Although some distant districts are afflicted to a great extent with fever and ague, no place can be found which enjoys a greater exemption from diseases than the city of Para, and the surrounding country; and there is perhaps no place having a greater uniformity of temperature. Situated so near to the equator, the changes in the barometer are almost imperceptible—the extreme variations do not amount to over two-tenths of an inch; varying from 29.90 to 30.10. The winds are also very regular; the land breeze generally blowing during the night and morning from southwest to southeast; and the sea breeze in the afternoon and evening from North to northeast and northwest. This wind is here called "Vento de Marajor," or Marajo wind, passing as it does over the great Island of Marajo, or "Joannes."

Meteorological Observations made daily in the city of Para, from May, 1845, to June, 1849, by Henry Bond Dewey, Esq.

COMMUNICATED BY DR. BOND.

	Mean temperature at sunrise.	Mean temperature at noon.	Mean temperature at 8 p. m.	Monthly maxima.	Monthly minima.	Mean.	Barometer—Mean of the month.	Days without rain.	Rain in inches from 16th February inclusive.
1845.	°	°	°	°	°	°	Inches.	No.	Inches.
January	76.10	85.77	79.81	90	74	80.56		3	
February	74 86	83 07	78.28	90	73	78.77		1	
March	75.68	84.16	78.93	91	74	79.59		1	
April	76.24	85.76	79.55	90	75	80.52		5	
May	76.64	87.03	80.58	90	75	81.52		5	
June	76 31	87.07	80.61	90	75	81.33		2	
July	75.74	87.52	80.56	90	74	81.27		5	
August	75.93	86.97	80.77	90	74	81.22		10	
September	75.93	87.77	81.57	90	74	81.76		14	
October	76.13	87.37	81.83	92	74	81.78		21	
November	76.27	88.10	82.17	92	74	82.18		14	
December	76.03	86.74	80.77	91	75	81.18		13	
1846.									
January	76.30	84.67	79.40	88	75	80.12	In.	None.	
February	75.80	83.80	79.20	89	74	79.60	29.91	None.	
March	75.19	81.35	78.61	87	73	78.38	29.98	1	
April	76.07	84.97	79.63	89	75	80.22	29.94	2	
May	76.74	87.03	80.74	91	76	81.50	29.960	3	
June	77.03	87.47	81.97	91	76	82.16	29.980	6	
July	77.29	90.32	83.19	95	73	83.60	30.020	18	
August	76.16	88.71	81.77	94	75	82.21	30.000	16	
September	76.10	87.93	81.53	92	74	81.85	29.610	12	
October	76 07	87.79	81.67	92	75	81.84	29.660	14	
November	76.33	87.60	81.53	93	75	85.15	29.90	14	
December	76.58	87.06	82.35	92	76	82.28	29.89	14	
1847.									
January	75.81	83.58	79.87	90	74	79.75	29.94	5	
February	75.00	84.64	78.36	90	73	79.33	29 95	1	
March	75.60	82.00	78.70	90	74	78.77	29.99	2	
April	75.70	82.73	78.43	90	74	78.95	29.99	1	
May	75.71	84.80	78.23	90	74	79.58	29.97	1	
June	75.40	86.71	79.41	90	74	80.51	29.96	7	
July	75.54	87.77	79.88	93	74	81.06	29.96	9	
August	76.07	88.33	80.35	92	74	81.58	29.91	6	
September	73.87	87.93	78.72	91	70	80.17	29.94	15	
October	75.84	87.23	80.19	92	74	81.09	29.94	13	
November	76.14	87.28	81.64	90	75	81.69	29.95	20	
December	75.79	86.14	80.07	92	74	80.67	29.90	15	
1848.									
January	75.71	86.45	79 58	90	74	80.58	29.84	1	
February	74.90	83.66	77.07	88	72	78.54	29.91	1	5.175*
March	75.03	83.90	77.61	88	73	78.85	29.90	3	12.284
April	75.27	82.90	77.53	87	74	78.57	29.93	None.	14.487
May	75.52	86.61	78.35	90	74	80.16	29 940	1	8.160
June	74.70	87.17	78.63	89	74	80.17	29.990	9	5.270
July	74.48	86.81	79.48	89	72	80.26	29.990	10	3.263
August	74.53	88.03	80.07	90	72	80.88	29.990	16	3.550
September	75.23	87.90	79.53	90	74	80.89	29.930	13	2.512
October	75.48	88.29	80.81	91	74	81.527	29.920	22	.700

* Observations as to the quantity of rain commenced on the 15th February.

Meteorological Observations—Continued.

	Mean temperature at sun rise.	Mean temperature at noon.	Mean temperature at 8 p. m.	Monthly maxima.	Monthly minima.	Mean.	Barometer—Mean of the month.	Days without rain.	Rain in inches from 16th February inclusive.
1848.	°	°	°	°	°	°	Inches.	No.	Inches.
November . . .	75.67	88.90	81.00	94	74	81 855	29.89	14	2.841
December . . .	75.74	87.06	80 58	90	74	81.128	29.81	15	2.353
1849.									
January	74 39	86.13	78.10	89	72	79.54	29.97	5	6.512
February . . .	74.11	83.39	76.89	88	72	78.13	29.92	3	10.902
March	74.61	85.48	77.10	90	73	79.06	29.92	5	10.896
April	74.25	83 93	77.21	90	72	78.46	29.94	4	9.711
May	75.51	86.52	78.93	92	74	80.32	29.93	4	12.027
*June	75.70	89.50	72.10	91	75	79.10	30.00	6	1.444

Amount of rain from 16th February to December, 1848, inclusive, ... 58.595 inches

Amount of rain from January, 1849, to June 10th, inclusive, ... 51.192

Total 109.787

Highest range of thermometer between January, 1845, and June 10, 1849, 95°, (on 26th July, 1846, at noon.)

Lowest do. do. do. do. do. do. 72°.

* To 10th inclusive.

No. of days in each month on which there was rain in Para in the years—

1845.	A. M.	Noon.	P. M.	Night.	1848.	A. M.	Noon.	P. M.	Night.
January . . .	3	5	23	5	January . . .	6	3	22	6
February . . .	10	8	23	1	February . .	8	8	24	7
March . . .	10	10	24	2	March . . .	9	22	17	0
April . . .	12	5	24	1	April . . .	21	23	20	10
May . . .	1	5	21	11	May . . .	2	6	21	7
June . . .	0	2	12	18	June . . .	1	2	12	11
July . . .	0	1	12	15	July . . .	1	0	7	13
August . . .	0	0	13	8	August . . .	1	0	10	5
September . .	1	1	15	3	September . .	0	0	16	4
October . . .	1	1	9	1	October . . .	0	0	8	0
November . .	0	0	14	0	November . .	0	0	16	1
December . .	1	1	12	5	December . .	1	5	11	1
1846.					1849.				
January . . .	14	10	20	2	January . . .	3	6	22	4
February . . .	13	9	19	1	February . .	12	12	20	7
March . . .	11	12	23	3	March . . .	5	7	21	5
April . . .	9	7	24	5	April . . .	8	4	19	4
May . . .	1	3	18	12	May . . .	5	4	20	16
June . . .	1	2	15	12	June* . . .	0	0	7	1
July . . .	0	0	11	8					
August . . .	0	1	9	7					
September . .	0	0	14	5					
October . . .	0	0	15	2					
November . .	1	0	11	4					
December . .	0	1	13	3					
1847.									
January . . .	10	10	17	6					
February . . .	6	10	20	6					
March . . .	19	15	19	1					
April . . .	9	6	17	11					
May . . .	2	6	25	8					
June . . .	1	0	18	7					
July . . .	1	2	15	8					
August . . .	2	0	13	16					
September . .	0	1	9	3					
October . . .	1	1	15	3					
November . .	0	0	10	0					
December . .	2	2	11	3					

* To 10th June inclusive.

1846. Bar., winter months	= 29.94 In.
" June, July, and August	= 30.00 "
1847. Bar., winter months	= 29.95 "
" June, July, and August	= 29.94 "
1848. Bar., winter months	= 29.88 "
" June, July, and August	= 29.99 "
Mean for winter months	29.92 "
" for June, July, and August	29.98 "
Correction for temperature	— 0 "

Maximum and Minimum Temperature, at Para, in Amazonia.

1845.	Sunrise.		Noon.		8h. P. M.		1846.	Sunrise.		Noon.		8h. P. M.	
	Max.	Min.	Max.	Min.	Max.	Min.		Max.	Min.	Max.	Min.	Max.	Min.
January . .	78°	74°	90°	82°	83°	75°	January . .	77°	75°	89°	79°	81°	78°
February . .	77	73	88	78	82	76	February . .	77	74	89	80	83	76
March . .	78	74	91	80	82	76	March . . .	76	73	88	78	80	74
April . .	78	75	90	81	83	76	April . . .	77	75	89	79	89	77*
May . .	78	75	90	84	84	77	May . . .	79	76	91	82	84	78
June . .	77	75	90	84	85	77	June . . .	78	76	91	85	85	79
July . .	77	71	90	84	84	78	July . . .	80	73	95	82	87	77
August . .	77	71	90	84	83	78	August . . .	77	75	94	84	86	78
September . .	77	71	90	85	84	78	September . .	78	74	92	85	84	79
October . .	77	74	92	85	84	79	October . .	77	75	92	85	86	73
November . .	78	74	92	85	84	78	November . .	78	75	93	86	84	78
December . .	78	75	91	80	84	77	December . .	79	76	92	85	84	80
1847.							**1848.**						
January . .	78	74	90	77	84	77	January . .	77	74	90	76	83	75
February . .	76	73	90	80	83	74	February . .	76	72	88	76	80	74
March . .	77	74	90	78	82	75	March . . .	76	73	88	80	82	74
April . .	76	74	90	79	80	76	April . . .	76	74	87	80	78	74
May . .	76	74	90	80	80	76	May . . .	78	74	90	83	81	76
June . .	76	74	90	80	82	77	June . . .	76	74	89	84	80	75
July . .	77	74	93	84	85	76	July . . .	76	72	89	85	82	76
August . .	78	74	92	85	84	77	August . . .	76	74	90	84	82	77
September . .	76	70	91	86	82	76	September . .	76	74	90	85	85	78
October . .	76	74	92	85	82	78	October . .	76	74	91	85	83	78
November . .	78	75	93	84	84	79	November . .	78	74	95	87	83	79
December . .	78	74	92	78	82	78	December . .	78	74	90	86	82	80
1849.													
January . .	75	72	89	82	81	73							
February . .	76	72	88	74	80	72							
March . .	76	72	90	82	79	74							
April . .	76	72	90	26	80	74							
May . .	77	74	92	84	83	77							
June . .	76	75	91	87	82	78*							

Extreme for 4 years—

Max. at sunrise 79°.	Min. at sunrise 72°.
Max. at noon 95°.	Min. at noon 74°.
Max. at 8h. P. M. 89°.	Min. at 8h. P. M. 72°.

*To 10th June inclusive.

By glancing over these tables it will appear that the rainy season extends from January to June inclusive, and that the rains are most prevalent and copious in February, March, April, and May; that the mean temperature at sunrise for any one month during a period of four years and a half, through which the observations

extend, was never less than 73°, nor more than 77°.29; that the climate is one of remarkable uniformity, as to temperature; that the barometer rarely stands as high as 30°, except in July and August—the dry season, when the S. E. trades prevail; that in the rainy seasons, when the calms prevail, it generally stands lowest; and that its range or fluctuations are small; that the time of day when it is most likely to rain, is P. M. the hottest portion of the day, particularly in the rainy season; and that in July and August—the height of the dry season—the rains are nearly equally divided between P. M. and night; that is, that even then, it raises on the average about as much and as often during the six hours from noon to sunset as it does during the 18, from sunset till noon next day; and that during the whole period of observation, the thermometer at sunrise was never less than 70° nor more than 80°; at noon, never less than 76°, nor more than 95°; and at 8 P. M., the minimum was 72°, the maximum only 89°.

Of course as all the air which the S. E. and N. E. trades keep in motion is discharged into the belt of equatorial calms, that air must escape from this belt first by ascending, and then by flowing off in the upper regions of the atmosphere. As it ascends, the pressure upon it is diminished; as the pressure is diminished, it expands; as it expands it becomes cooler; as it becomes cooler the heat which is required to keep suspended a portion of the moisture with which it is charged, is abstracted from the vapor; and as the vapor loses its caloric, it is condensed. It then falls in the shape of rain.

Now in the afternoon at Para, when during the rainy season the heat of the sun is felt in its greatest intensity, this atmosphere becomes still more rarified. It ascends, on this account, the more rapidly and expands more freely: it cools faster in the upper regions, and then its vapor is condensed and comes down in the shape of water.

Now it is obvious that at each rain upon the land the atmosphere is permanently relieved of a portion of its load of moisture; that although, after the rain, a considerable portion of the moisture which has been deposited is evaporated up again; yet there is always a portion which runs off into the rivers or sinks into the earth to feed the springs, &c., which is not evaporated again before reaching the sea.

For these reasons, we perceive that the trade winds, as they blow up the great valley of the Amazon, are gradually depositing their moisture as they go; therefore they become drier and drier. And that in order that such deposition of moisture and process of drying may go on, the temperature at which condensation takes place, must be lower and lower all the way up from the mouth of the Amazon to its sources among the Andes. Thus, for instance, the winds which blow up the valley, arrive at Para loaded with moisture up to the temperature of 80°, we may suppose. In passing Para they are subjected to a temperature, we will also suppose, of 75°. Of course, then, all the moisture, which by the abstraction of this 5° of heat would be condensed, is showered down upon Para as rain. Some of this rain sinks into the earth to feed the springs, and some runs off to fill the rivers, so that the atmosphere does not take it all up again. Consequently the dew point at places above Para, is not so high as it is at Para, and to get the same quantity of rain to fall in the interior that falls at Para, the vapor of the atmosphere must be subjected to a lower degree of temperature than it was at Para.

Thus we have reason for the conjecture that the minimum degree of temperature, even upon the Equator,

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in this part of the world, is less and less as you ascend the valley of the Amazon. If it be not so at the surface of the earth, it is certainly so in the cloud region; for the trade winds as they blow up that valley drop down the waters which make the Amazon and its tributaries. Finally, reaching the regions of perpetual congelation as they pass over the Andes, they part with all the moisture which that temperature can extract.

Tumbling down the slopes beyond, they receive no fresh supplies of vapor between the mountains and the Pacific ocean, consequently we have along the coast of Peru a rainless region.

These observations show clearly enough that as the belt of equatorial calms passes over Para, the mean height of the barometer is less than it is in the extra-tropical latitudes generally, or than it is when the trade winds prevail at Para.

There is no route on which close attention to the barometer while crossing these calm belts, will be of more service to the navigator than on the California route from Panama.—*See that Chapter.*

In the calms of Cancer and of Capricorn, there is a descending instead of an ascending current of air; therefore the barometer ranges higher, on the average, within those two calm belts than it does anywhere else. The difference, however, does not exceed the tenth of an inch (0.1.) Close attention to this instrument will often enable the navigator to decide when he has crossed this belt and got into the region of Trades, even before he gets the wind from the trade quarter. He determines this by its fall.

The passage between Australia and California should be made ordinarily in from 40 to 45 days:—the passage to the East being rather the shorter; of course clipper ships will generally bring the passage within 40 days or less. See the remarks about the Farallones in the sailing directions for California from the United States, page 433.

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*Sailing Directions for entering the Ports of the Society Islands.**

As the Society Islands are rapidly increasing in importance, navigators visiting them will find the following sailing directions of sufficient value to justify their insertion here.

For their appearance in this place, mariners are indebted to our Consul, Wm. H. Kelley, Esq., who transmitted them from Tahiti to the State Department. *April*, 1852.

In the island of Tahiti there are eleven good harbors, namely, Taunoa, (properly Taaone,) Papeete, Rautirare, Temarauri, Tapueraha, Vaiau, Vaiurua, Vaionifa ,Tefaanoô, Pueu and Vaitoare ; in addition to these harbors, which are the principal ones, there are the following smaller and inferior ones, namely, Taapuna, Maraa, Teahifa, Hotumatuu, Teputa, Havae, Temotoi, Hitiaa, Mahaena, and Papaóa.

Taaone on the N. W. side, (known as Taunoa,) has both a good entrance and anchorage. The latter is in 13 fathoms on the east side of the bay ; from this harbor there is a good passage inside the reef to Papeete, the harbor of Taaone may be known by a peculiar mountain at the head of Faatua valley, much resembling a crown ; when the crown opens on the eastern side of the valley, you are abreast of the passage.

* Sailing directions for entering the ports of Tahiti and Moorea, by Captain S. P. Henry, Pilot, Tahiti : Printed for Government at the London Missionary Society's Press, 1852.

Papeete harbor is perhaps the best in Tahiti; the passage, though, is narrow, in consequence of a bar extending from the Southern reef, two-thirds across the passage; in entering it is necessary to keep close on the larboard hand.

Taapuna passage, on the west side, is about five miles to the southward of Papeete, and is small and difficult, having shoals in the centre of it. Course in N. E. by E. When inside the reef, keep close to the east side to avoid the shoals, which can be seen from the mast-head; when in, haul to the northward into good anchorage. There is a good passage from Taapuna to Papeete inside the reef. At Taapuna the current sets out. On the shoals the water is from 1½ to 3 fathoms; between them the water is much deeper.

Maraa passage is on the S. W. side of the island; course in N. by E. Keep close on the starboard hand after entering the outer reef.

Pass, if possible, to the eastward of the shoals which lay in the inner part of the passage: but a vessel can pass either between or to the westward of them. Close to the east shoal on the eastern side is a small sunken patch; but this is only to be feared by vessels of a heavy draught of water. Good anchorage in shore abreast of the passage, off a water run. There is a good passage for ships inside the reef from Maraa to Papara, where they can anchor at the Piraa orie—the current sets out at Maraa to the S. E.

Rautirare passage at Papeuriri is good with a fine harbor. In standing in for Papeuriri there are two small islands to be seen inside the reef. These two islands are a good guide for the passages of Rautirare and Reahifa. The eastern island is situated close to the east side of Rautirare passage, the other is about a mile to the westward, and the passage of Teahifa in Mairipehe to the westward of that.

In entering Rautirare on the eastern side, particularly if the wind should be light as the current sets down on the lee or western reef, the course in is N. N. W. After entering the reef keep on the starboard hand. There is good anchorage under the island, although anchorage can be had in any part of the bay. The bres is in the next bay to the westward near the island. Keep close to the point in passing, for although the passage is good it is narrow. In leaving this anchorage, you have the advantage of the passage of Teahifa, it is narrow, but safe at most times. Keep close to the east side of the reef to avoid a bar which runs from west side half passage.

The course, in Teahifa passage, is N. N. W.; anchorage in shore of the island, or to the westward half a mile off Mairipehe.

Temarauri at Papeari, on the south side of the island, near the isthmus, is a good passage. Course in N. W. ½W. There is a small shoal in the centre of the bay, but it can easily be seen from aloft. You must pass to the westward of it, then steer for the point of Motuoini, which must be passed close. There is good anchorage around the point to the westward; small vessels can run to the westward and go out of Rautirare at Papeuiri, the currents sets out of Temarauri to the southward.

Hotumatuu on the south side of the isthmus is direct in for Taravao, but it can only be attempted by small vessels having a fair wind; there are two or three shoals in the passage, but they are seen from aloft.

Teputa passage is close to Hotumatuu, facing the Taiarapu side. It is narrow, but has plenty of water

and free from shoals; as it can only be entered with a fair wind, it can be seldom used, but it is a good passage to go out by as the wind in general is from off the isthmus—the current sets out to the southward.

Tapuaeraha, on the West side of Taiarapu, has a fine and large entrance. Course in, N. E. by N. In entering, keep well on the South side, as from the North side the shoal or spit runs off some distance; in general, here there is a heavy rolling sea; after you are inside, you can anchor in any part of the harbor. There is a good passage inside the reef from this harbor to Taravao, which is generally taken by ships, more especially heavy ones. It is, however, rather difficult for large ships to enter this harbor of Tapuaeraha, as the wind mostly blows out, and it is not prudent to tack through fear of missing stays, the wind being so baffling off the mountains. The best way of entering is to round the reef as close as possible, then luff up, clew all up, and let go the anchor; then warp in till you have sufficient room to make sail to work up the harbor. The current sets from this passage to the southward.

Havae, at Teahupoo, on the south side of Taiarapu, has a good entrance, course in, N. by E. ½ E.; the anchorage in the bay is only good in fine weather. For small vessels there is a narrow passage to the westward, close in shore into the next bay, where the anchorage is safe. There is a passage for small vessels inside the reef from Teahupoo to Mataoae.

Vaiau, on the S. S. E. part of Taiarapu, has a fine harbor—course in, North. After entering the reef, haul up to the N. E., towards a low point into good anchorage, the current in this passage sets to the S. E.

Off the Pari, on the S. E. part of Taiarapu is a dangerous rough place full of sunken shoals, extending two or three miles off the land, and about four miles along the coast, finishing at the Motoî, which is to be known by two small islands. There is an inferior possage at the Motoî. course in, W. N. W. In going in or out, haul close round to the North reef to avoid the sunken shoals, having the two islands on the starboard hand in entering, haul round the islands to the northward into anchorage.

Vaiurua, on the eastern part of Taiarapu, has a good harbor, course in, S. W. This harbor is about two miles North of the islands at the Motoî.

Vaionifa, on the N. E. part of Taiarapu, has a good entrance, course in, S. W. by S. the anchorage is extensive. After entering in hauling to the southward, there is a shoal—vessels can pass on either side of it. There is a passage inside the reef from this harbor to Vaiurua. Vessels can enter and depart by either, as the winds may allow. There is also a good passage from this harbor close down to Tautira point.

Tautira bay is exposed to the westerly winds, and only to be recommended in fine weather. The best anchorage is close on the N. E. side under the point; on the S. W. side of the bay is a good harbor called Tefaaô. Vessels entering the bay of Tautira should steer to the S. W. and then enter the reef to good anchorage; from Tefaaô vessels can go inside the reef to Pueu.

Pueu has a good passage, course in S. S. E., in entering, haul round the West side of the reef, and steer to the westward around the first point, and come to anchor off the village. In leaving Pueu, vessels can go out of a passage to the westward.

Vaitoare harbor about two miles North of the Isthmus, has a fine and safe anchorage. Vessels can enter or depart from the northward or southward, but the northern passage is the best.

Tematoe—About two miles to the southward of the point of Hitiaa, there is a good entrance into the reef, called by this name of Tematoe, vessels can pass inside close to the point of Hitiaa, into good anchorage.

Hitiaa is on the N. E. part of Tahiti, but the harbor is not good, the bottom being very rocky. After entering the reef, haul to the northward, and anchor near a small island. In leaving Hitiaa, vessels can go out by Mahena, the best anchorage at Mahena is in shore of a small low island, known as Nansouty's Island.

Point Venus.—The bay of Point Venus is exposed to the westerly and northerly winds. The anchorage is sufficiently safe, excepting in the months of December, January, February and March. In entering the bay, haul close round the reef on the East side, passing in between the reef and the Dolphin bank—Anchorage under the Point, about two cables' length from the shore.

Papaoa is on the N. W. side, and about three miles to the southward of Point Venus, it has good anchorage—there are, however, several sunken shoals inside the passage, which pass outside of, keeping along the outer bank; the best anchorage is at the head of the bay.

It would not be prudent for ships running to the westward along the North side of Tahiti, more particularly large vessels, to approach the land closer than 3½ miles, as there are sunken shoals lying off in different places—These shoals commence at Mahaena, extending to the westward, as far as a small island that lies a little to the eastward of Point Venus.

Vessels bound to Papeete, if there should be any southing in the wind, must bear in mind that the breeze will not reach the passage; sometimes only as far as Point Venus; other times it will reach to Taaone, and in some particular cases close to Papeete, but never as far as the passage. When you get in shore off Papeete, there will be an eddy wind from the Southward and Westward; in such cases it will be well to keep off shore in the line of the sea-breeze. When Papeete passage bears S. E. haul in shore gradually into the calm or variable winds, which is always the case between the two winds. In most cases, after a little time you will have a S. W. or Westerly light breeze which will gradually increase as you near the passage, for the closer in the stronger the eddy wind; you will often find twice the wind inside the reef that there is outside.

At times vessels coming down from the Eastward, after passing Point Venus, are left suddenly in calms or with light variable winds, the sea-breeze hauling off, in that case it is advisable to keep in shore if possible, making short tacks for the harbor, as the the eddy wind before mentioned, is stronger close in when placed between the two winds, as a vessel may be becalmed a whole day, with no chance of getting into port; at times, the Easterly wind will carry a vessel to the harbor's mouth; when inside the mind is the contrary way; when this is the case, you can make bold to stand in, keeping as close to the Southern bar as is prudent, standing by to brace round the yards as soon as you feel the air. In standing in with a good breeze, if the wind should leave you in the passage, and it should be calm inside, the way the ship has will carry her either to her anchorage or within reach of the buoy, enabling her to swing clear of all danger. The buoy has been placed for the purpose of running a line to haul up to, and so prevent the necessity of dropping an anchor. It would be

well to have a good line or hawser ready in case it might be needed. In all cases the state of the passage with regard to the current and sea must be considered before attempting to enter, but this can be observed as you approach, the current sets down inside the reef from the Southward towards the island Motuuta, and the reefs on the larboard hand entering. From the Eastern side of the outer reef, the current strikes to the S. W. pressing down to the lee bar of the Western side and along the reef; it is necessary when there is any current to keep close to the Eastern reef, to avoid the bar; in fine weather it is deceiving, as the passage appears wide, but in heavy weather, the sea breaks on it, leaving in many places, only from 1½ to 2 fathoms water.—Close to the Eastern reef, there is a small sunken shoal in the mouth of the passage, but as there are three fathoms water on it, it is only to be feared by large ships. In the months of January, February and March, the passage of Papeete is in general bad with a high sea and strong current, during which time vessels have to enter by the Taunoa passage. Vessels wanting a pilot will do well to wait off Taunoa passage, as he can then bring them in by either of the passages as his judgment may dictate to him. Moreover, as the current generally sets to the southward between Tahiti and Moorea, ships getting to leeward, may have some difficulty in working up.

For ships going between Tahiti and Moorea, bound to Taravao, Taiarapu, etc., a northerly wind is a fair one through; with an Easterly wind it will be necessary to keep well on the Moorean side, in order to profit by the breeze as long as possible, passing three or four miles from the S. E. point of Moorea, and then gradually hauling to the Eastward; after losing the Easterly wind it is probable that you may have a Southerly breeze which will enable you to head to the Eastward; towards night it will be necessary to haul in with the Tahiti shore, to profit by the land breeze, that in most cases will carry you past Maraa into the sea breeze, advantage must be taken of the land breeze, as often in the day time you may lay becalmed between the two breezes. After having passed Maraa, and working up to the windward for Taravao, it will be well to keep an offing towards the morning, for although the breeze still keeps up in shore, it is much influenced by the land breeze; about 10 o'clock the sea breeze comes in true, often from the Southward and Eastward which will give you a bold reach up for Taravao.

Ships leaving Papeete, bound to the Southward for Valparaiso, &c., should, in almost every case, go to the Westward of Moorea, passing the lee point of Moorea six or eight miles.

Sailing from Taravao, bound to Papeete, with a fair wind, steer W. S. W. until you open the South part of Moorea with Maraa point, then steer West till the North end of Moorea is open with Maraa, changing the course to W. N. W. which will enable you to pass the reef off Maraa two or three miles distant. When the extreme point of Bunaauïa is open with Maraa, bearing N. N. W. ½ W., the extremity of Maraa reef will bear N. W. ¾ N.; North end of Moorea, N. W. ½ N.; then steer N. W. by W. until you have passed abreast of Maraa, having the channel wide open; then change the course to N. W. by N. ½ N. which will carry you between the islands clear of everything, as the current sets generally on the Faaa reefs, called the Rapa Tiaini, it would be well not to haul in too soon for Papeete—not until you are abreast of Faaa reef; as frequently the S. E. wind will carry you that point and leave you in a calm, with perhaps a heavy swell from the Southward

or Northward, together with a current setting towards the reef, likewise with S. E. winds. It is often the case that when the wind leaves you in calm, it is followed by a light air from the Northward and Westward, so that it is an advantage to have a little offing to fetch Papeete.

Leaving Taravao, with the wind blowing over the isthmus from the Eastward, it will be necessary to keep well off the point of Maraa, well over to the Moorean shore, for under the Tahiti shore there will be light and variable winds; haul gradually to the Northward, and as you lose the breeze it is probable that you will have a light eddy wind that will enable you to lay well up on the larboard tack.

From June to November, the Southern part of Tahiti is frequently subject to high sea and strong current, and the sea is heavy on the reef from the Rapa Tiaini at Faaa, round the south part of the island as far as Hotopu on the S. E. part of Taiarapu. From December to May the high sea and current is experienced on the Northern part of the island from Hotopu to the Rapa Tiaini.

In stormy winds there is a strong current off the east end of Taiarapu; in southerly winds the current sets to the S. E., and in northerly winds to the N. E. Along the northern side of Tahiti, the current generally sets to the Northward and Westward; on the south side to the S. E. In westerly winds the current frequently sets the contrary way. On the west side of Papeete, and between the islands, the current generally sets to the southward, between Tahiti and Moorea, particularly in strong southerly winds; with northerly winds the current sets to the Northward.

Sailing Directions for Entering the Ports of Moorea.

In the island of Moorea there are four good harbors, namely: Taareù, at Papetoai; Cook's harbor, at Paopao; Papeare and Haumi.

Papetoai is the best harbor, and is situated on the northwest side of Moorea. It has a wide entrance and extensive anchorage. There is but little current; what there is sets to the westward, along the reef. Vessels entering or coming out must keep on the eastern side of the passage.

Paopao, about three miles to the eastward of Papetoai, has a good harbor. The best anchorage is at the head of the bay.

Papeare is on the northeast part of the island. It has a good entrance, with safe anchorage at the head of the bay.

Haumi is on the east side. The passage is narrow but good, with plenty of water. After entering the reef, anchorage can be had either to the northward or the southward.

Sailing Directions from Panama to California and the Northwest.

The passage under canvass from Panama to California as at present made, is one of the most tedious, uncertain, and vexatious that is known to navigators.

The voyage from Valparaiso to California is a shorter one, in point of time, than is that from Panama, though the latter, as it regards distance, is not half as long as the former.

A brother officer of the Navy, writing from San Francisco, says:

"I learned, on my arrival at Panama, that great numbers of sailing vessels were in the habit of resorting thither for the purpose of taking passengers and freight to San Francisco; but to my surprise I heard that they seldom made the passage under 90 days, and often were 120 days on the way. There were then many vessels there, all ready to sail, and among them the clipper ship 'Hornet,' none of which has yet arrived though 53 days have intervened.

"One of the clipper ships sometime since made the passage in 45 days, by standing to the southward as if bound to Callao, and making all her westing in the S. E. trades, south of the line. This is such a round about way of getting to San Francisco from Panama, that there must be something wrong in the courses steered by the vessels which take the northern passage. It is well known that there is a strong westerly current running past the Galapagos Islands, which, by my own experience on one occasion, I found to be sixty miles in 24 hours. This current extends to the eastward almost to Point Malo, and westerly entirely across the Pacific, though not so strong as in the vicinity of the Galapagos. It strikes me that navigators with proper instructions as to this current and the prevailing winds, ought always to make this passage in certainly not more than 40 days.

Knowing that you had few if any abstracts of this passage, I took the liberty of telling Capt. Goodrich that these logs would be valuable to you, and suggested that he get as many of them together as possible and send them to you."

That this voyage can, with a better knowledge of the winds and currents than navigators now possess, be shortened very considerably, I have no doubt.

But, unfortunately, only a few of the vessels in the Panama trade, send me abstracts of their logs.

As soon as I can collect materials enough to justify a discussion of this passage, I will undertake it. In the meantime, drawing upon such slender sources of information as I chance to have, I venture the following suggestions as to the route from Panama to the northward and westward. I say *suggestions*, for my information is not sufficient to justify the application of the more positive term of "Sailing Directions" to the remarks I have to make.

I have more than once, while preparing this work, called the attention of navigators to the system of monsoons off the Pacific coast of Central America. It is this system of monsoons and the calms or "Equatorial doldrums" as they are called, which are always to be found between the N. E. and the S. E. trade winds

or between the monsoons and each of these two systems of winds, that contribute so much to the prolongation of the passage from Panama.

Of course, where two winds meet from different quarters, every navigator knows he must have a belt of calms or light baffling airs; for a wind from the N. E. and a wind from the S. E. cannot blow each at the same time and place. Therefore, when two such winds meet, their line of meeting is marked by calms and baffling airs.

Now my investigations have been carried far enough to show that at certain seasons of the year, a vessel bound from Panama to California, must cross at least three, at some seasons four, such meetings of winds, or bands of calms, before she can enter the region of N. E. trades. Hence the tedious passage.

But, although the researches connected with these charts have revealed this fact, the materials upon which they are founded are not sufficient to show with certainty the best way of avoiding these calm and baffling regions.

In the absence of more special information, and in view of the important interests to be subserved by a shortening of the passage from Panama to California and Oregon, I venture the following suggestions as to that passage. These suggestions derived from the light which the experience of those Panama traders whose logs I have, cast upon the subject. But this light is feeble, because the materials whence it is derived are meagre. Still they amount to several thousand observations carefully made; and in the aggregate they are worth more than the experience of any single navigator in that trade can possibly be. Nevertheless, I do not ask for them that degree of confidence to which the "sailing directions" given in this work are generally entitled. These suggestions, added to individual experience, will probably be found by navigators to be of some service.

In the discussion of the winds as it is conducted for the Pilot Charts, Panama and its approaches are included between the parallels of 5° and 10° N. Between these parallels and East of 85° West, it appears from the observations which have been discussed, that the prevailing winds in November, December, January, May, June and July, are between N. W. and S. W. inclusive; that in December, January, February and March they prevail about one-fifth of the time from the northward and eastward; that calms are least prevalent in the month of March, the prevailing wind for March being N. W.; and for June S. W.; though N. W. winds are also frequent in June; and that for the other months, the observations are too few to give any indication as to the prevailing winds.

Between the same two parallels but to the west of 85° and as far as 95°, the prevailing winds are, in December, January, and February, N. E.; in March and April they are variable, prevailing alternately from N. E. and N. W. In May, June, July, August, and September, they prevail from South to S. W. inclusive; in October from S. E. to S. W. inclusive. In November they are inclined to variable, though from S. E. by the way of South to W. S W. is the favorite quarter.

It is moreover indicated that to the east of 80° the winds in December, January, and February, prevailing as they do from the northward and westwarrd, are generally favorable for getting to the southward and westward, by steering S. S. W. or S. W.; that in May, calms are frequent, and the prevailing points of the

wind are decidedly W. S. W., S. W. and S. E.; and in June W., W. S. W., S. W. and N. W. But as the favorite point is west, and calms are not so frequent as in May, June appears to be a more propitious month than May for crossing the parallel of 5° N. by a southwardly course from Panama. Between 5° and 10° N. for the other months. I have not observations enough to the east of 80° to justify me in any remarks as to the winds.

Neither have I observations enough for January, February, or March to the east of 80° and between 0° and 5° N., to authorize deductions; but for all the other months of the year, they are abundant. They show that to the east of 80° between the equator and 5° N., the winds are steady between S. E. by the south to west, and that calms are most frequent in this part of the ocean during the months of December and April. The points from which the winds most prevail are, in December S. W.; in April S. S. W. and S. W.; in May, June, and July, S. W.; in August, S. S. W. and S. W.; in September, S. W.; in October and November from S. E. to W. S. W.

Between 80° and 85° West from the equator to 5° N., the prevailing direction of the wind all the year, is between S. E. and West by the way of South; though from March to August, inclusive, it is most inclined to be variable. In December, March, and April calms are most frequent.

Between 85° and 90° the prevailing quarter for the wind, all the year, from the equator to 5° N., is between S. E. and S. W. It is most variable from January to June, inclusive. In March and April, the N. E. trades are frequently found here—calms are most prevalent in March.

Continuing West between the same parallels, the region from 90° to 95° West, seems to be of all, the most liable to calms the year round. From October to January inclusive, they are not so frequent as in the other months, being less frequent in October.

From S. E. to S. S. W. is the ruling quadrant for the winds here all the year; though from January to June inclusive, they go from N. E., around by the way of East, to West.

To the West of 95° they are steady between S. E. and South, except from January to May inclusive. In January, February, and March, they often get as far North as N. E. and in April and May as far as E. N. E.

Now then, after carefully studying this description of the wind, derived, it is true, from no great abundance of materials, I have to suggest the following routes for the consideration of navigators bound northwest from Panama.

From the Bay of Panama make the best of your way South until you get between 5° N. and the Equator.

Being between these two parallels, it will be for the navigator to decide whether he will shape his course west, and keeping between them until he crosses the meridian of 95° West, or whether he will cross the Equator, and make his westing in South latitude, with the Southeast trades on his quarter. The winds that he finds between 5° and the Line should decide this question for him. If he can get west here, with a good breeze, he should crack on, and when his good wind leaves him, steer S. again.

If the passage from Panama be attempted in January, February, March, April, May, or June, time will probably be saved by going South of the Equator; for at this half of the year the Northeast trades and the

Equatorial "doldrums" are often found between the Equator and 5° N. Between the meridians of 80° and 85° West, in this part of the ocean, these winds and calms are found even in the months of July and August. Therefore, in coming out of Panama, and after crossing 5° N. in any season, make a S. W. course, if the winds will allow. If the wind be S. W., brace up on the starboard sack; but if it be S. S. W., stand West, if it be a good working breeze. But if it be light and baffling, with rain, know that you are in the "doldrums," and the quickest way to clear them is by making all you can on a due South course.

Suppose that after crossing 5° N., you have got to the West of 85° without having crossed the Equator. Now, if the time of the year be in that half which embraces July and December, the prevailing winds will be between S. E. and South inclusive, and the course is West as long as there is a breeze; as soon as the breeze dies away, and you begin to fight the baffling airs, conclude that you are in the vicinity of the "doldrums" that are often found here, either between the N. E. and S. E. trades, or between one of these trades and the system of southwardly monsoons that blow North of the Line, and between the coast and the meridian of 95° West.

These belts of "doldrums" lie East and West, and the shortest way to cross them, is by a due North and South line; therefore let it be a rule, whenever the navigator finds himself in one of these calm belts, to make all the latitude possible, for by that means he will soonest clear it.

Having crossed the meridian of 95°, stand away to the Northward and Westward with a free wind.

West of Long. 100°, and between the parallels of 5° and 10° N., the winds, in the months of November and December, are variable between N. E. and South, by way of East. In January, February, and March they are quite steady as N. E. trades. In April they are variable. The doldrums are generally found between those parallels in this month. During the rest of the year the winds are all the time between S. E. and S. W.

It will be well to cross the parallel of 10° N. at least as far West as the meridians of 105° or 110° W. Here, between the parallels of 5° and 10° N., the winds in November are steady from S. S. E. and S. December, April, and May are the months for the "doldrums" in this part of the ocean.

Having crossed the parallel of 10° N., between 105° and 110°, the navigator is then in the fair way to California. See Sailing Directions for California.

In making the West coasts of Mexico and the United States, the kelp is said to form an excellent landmark. This weed is very long and grows on the rocks at the bottom. When, therefore, in approaching the coast, you come across lines or swarths of tangled kelp, its being tangled or matted is a sign that it is adrift. It is afloat in deep water, and you may sail boldly through it without fear. But when you come across it tailing out straight, it is then fast to the rocks at the bottom, and it is dangerous to get among it.

The sketches of headlands along this coast, marked A, B, C, D, E, and F, were kindly furnished me by Lieut. Simon F. Blunt, and Passed Mid'n A. W. Johnson, U. S. N., those marked G. (West Coast of Africa, by Lt. Porter, U. S. N. To all three of those gentlemen I take this opportunity of acknowledging my obligations for this useful information and much valuable assistance.

The following sailing directions for entering the port of Acapulco, are by Lieut. Blunt:

"In making Acapulco from the North, keep close to the beach, (there are no out lying rocks,) and when the beach ceases, commences the high lands seaward of Acapulco. When near the harbor, say three miles off, the Island will begin to show pretty plainly, and the narrow passage between it and the main will be visible; and further along will appear another headland not unlike the Island, which, though apparently disconnected, is joined to the main by a low neck. Beyond the former, and to the North of the latter is the entrance.

"To steer in, keep, when to seaward, close to the Island, and passing it, stand over to the southeast shore to avoid some rocks which lie southward and east of the end of the Island, which rocks are above water but low. After passing these rocks, keep close to the left hand point, (say one hundred yards off,) and steer in for the town, leaving the Fort on the right, and running up within a cable's length of the beach if desirable. All the shore on the left is bold. These directions are for the night, and the main thing is to keep close to the beach. In the day time it can scarcely be missed. Water is procured from wells and towed off in casks. Fruits and fresh provisions are abundant, with plenty of poultry, eggs, &c."

In homage of science and of the enterprise, I recommend for observance, the following

"NOTICE."

"Trinity House, *London, December 23d*, 1851.

Notice is hereby given, that in order to prevent mischief occurring to the Sub-marine Telegraph, it is desirable that vessels should not anchor off the South Foreland when the high light-house bears between N. and N. W. and within the distance of three or four miles from the shore; nor if beyond that distanee, when it bears N. W. by N., on which bearing it will appear in one with a dark patch on the cliff.

And as respects the opposite, or southern side of the channel, it is equally desirable that vessels should not anchor when the two conspicuous windmills which stand on the high ground between Calais and the Village of Sangatte, bear between S. by E. and S. E. by S. By order,

J. HERBERT, *Secretary.*"

Conditions upon which the Wind and Current Charts are furnished to navigators.

These charts are based upon information collected for the most part by private ship owners and masters. The information being furnished to the Government gratuitously, the Government incurs the expense of publishing it and of making it available to navigators. The Government then offers a copy of the chart so published to every navigator, upon condition that he will continue to keep and forward to this office abstract logs of his voyages, which abstracts are required to be kept according to the form herein prescribed.

Every navigator, who, after receiving a copy of the charts, fails to comply with these conditions, viz: to keep abstracts of his voyages as per form, and to transmit them to me at the National Observatory on his return to the United States, forfeits his claim to all future publications.

The charts are to be had on application either at the National Observatory, Washington, or of George Manning, New York; provided the applicant will conform to the agreement stipulated, in the following form of the receipt, which he is required to sign for such charts as he may receive.

FORM OF RECEIPT.

Received this day of 185
from one Abstract Log, one Copy of
Maury's Sailing Directions, edition, and
sheets Nos. (*Series A.*)
do. do. (" *B.*)
do. do. (" *C.*)
do. do. (" *D.*)
do. do. (" *E.*)
do. do. (" *F.*)
MAURY'S WIND AND CURRENT CHARTS; *for, and in consideration of which, I promise to keep, in the manner and form prescribed, a journal of my Voyages, and on my return to transmit the same to the National Observatory, Washington.*

____

Commanding ______________________

of ______________________

Bound ______________________

A form of the Abstract Log is appended, and I take this opportunity to say, the *point* of the compass from which the wind blows is what is wanted, also the variation *observed*, and not the variation that is taken from charts or books.

☞The Abstracts are to be bound. Navigators in keeping them and in cutting the leaves out to be returned to this office, will please bear this fact in mind—and leave blank margins for binding;—and enter their winds, remarks and the like, so that all for the same day may be read at one opening, as on the pages 486, 487.

And whalemen will please recollect that their abstracts must embrace for *every day they are not at anchor* a regular record of their Lat. and Long., force and direction of the wind three times a day, temperature of the air and water, and mention of whales whenever seen.

ABSTRACT LOG of the

Date.	Latitude, at noon.	Longitude, at noon.	Currents, (Knots per hour.)	Variation *observed.*	Bar.	THER. 9. a. m.			WINDS.	
						Air.	Water.			
							Surface.	Below,* — feet.	First Part.	Middle Part.

☞ Leave broad margin.

☞ NOTE.—Frequent mention has been made and much stress laid in this work as to the peninsula of cold water, in the North Atlantic, and as to the probabilities of soundings far to the southward and eastward, as well as to the northward and eastward of the Grand Banks.

The ship "Hudson," Capt. Simpson, is said to have got soundings in 35 fathoms—mud—about Lat. 45° N., Long. 43° W.

Capt. M. D. Ricker, of the "Antarctic," on a voyage last June from New Orleans to Liverpool, reports a most remarkable change both in temperature and color of the water—the former may possibly have been caused by an iceberg, still it is very desirable to have more temperatures and soundings near the same place. This phenomenon occurred between his position, Lat. 30° 38′ N., Long. 63° 6′ W., at noon, June 24th, and his position the next day at noon, viz: 39° 44′ N., 61° 2′ W.

I quote from the very excellent and valuable abstract that he has returned to this office.

Sea Account, June 24, 1851.

"At 1 P. M., observed the water to be much changed from a blue to a very light green, caught up the thermometer and hove it over, and looking at it I was very much surprised to see that it had fallen 11 degrees since 9 A. M., which was then 77, and I judged within the influence of the Gulf. One hour after, it had fallen to 54°, and in 25 minutes after, to 52; the color of the water a very light green, the ship going about four knots to the eastward with a light breeze from the west. At 3 P. M., a fog bank was approaching the ship from the N. N. W. and N., which soon enveloped the ship in a cold mist, and changing the wind to that quarter, and bringing with it some considerable swell. Observed great quantities of chips, rock-weed, and some few sprigs of gulf-weed. Luffed the ship up in the wind and tried for soundings with the patent lead, but in the hurry did not get down but about eighty fathoms—no bottom—4 P. M., water 56°, at 8, 66°, and at 12, 70°, wind W. by S.

"I notice on the chart there is a bank or shoal laid down in this neighborhood, called Anne Bank, and in the 'Memoir Atlantic Ocean,' it is called ———— Reef, the position of which has not been very accurately determined. It is mentioned as being in about Lat. 39° N. and 64° 20′ W. Our latitude by observation, one hour before I tried the water, or at noon, was 39° 38′ and longitude by a good chronometer 63° 06′—[two, in fact, very good ones.]

"I think if there was any bottom there, we had probably got past it before I sounded. During the following twenty-four hours we have had very little, if any, gulf current."

* State how many feet below the surface comes the water which gives the temperature in this column.

Commander, bound from **to** **18**

WINDS.	REMARKS.
Latter Part.	

Enter under this head, force of wind, kind of weather, state of barometer just before, during, and after gales of wind. The changes, and the time of changes, of the wind during gales; sudden changes in temperature or color of the water, and the time when such changes are first and last noticed.

Discolorations of water, tide-rips, sea-weed, and drift. Flocks of birds. Whales, stating whether they be sperm or right, in shoals, pairs, or single.

Always mention thunder, lightning, fogs, rain, snow, dew and hail, meteors and auroras, &c., pumice stones found floating at sea, fall of dust, &c.

When falls of dust or red fogs are encountered, collect and send specimens. It is very desirable to have specimens of sea or sirocco dust from the Pacific and Indian oceans, and China seas. Note also, all atmospherical or other phenomena of interest to navigation.

And when any of the routes herein recommended are tried, state whether you have had a longer or shorter passage than vessels sailing about the same time *without* the "Wind and Current Charts" on board, or without having tried these routes.

It is very desirable to know the temperature of the water, even for a few feet below the surface. Therefore, those vessels that are provided with the means of letting water into the hold, would render a valuable service by drawing a bucket of water through the cock daily, and recording its temperature. Let the water so drawn run a little while first, so that it may be of the natural temperature. State the depth of the cock below the water in the column for water temperature "Below."

☞ Keep your Abstracts on paper of this size, and leave a *large* margin in the middle for binding.

☞ **Leave broad margin. Don't *cut* the leaves, but tear the stitches out when you want to return a part of the Abstract before all of it is filled.**

LIST OF THE WIND AND CURRENT CHARTS PUBLISHED UP TO THE FIRST OF JANUARY, 1853.

North Atlantic Track Charts,			8 sheets.
South do.	do.		6 "
North Pacific	do.		sheets 10 and 11.
South do.	do.		" 5 and 10.

North Atlantic Pilot Charts,			2 sheets.
South do.	do.		2 "
Cape Horn	do.		2 "
Coast of Brazil	do.		1 "
North Pacific	do.	(Nos. 5 & 6)	2 "
South do.	do.	(No. 6)	1 "

Trade Wind Chart of the Atlantic,	1 sheet.
Whale Chart of the World,	4 "
Programme Whale Chart,	1 "
Thermal Charts of North Atlantic,	8 "

CONTENTS.

EXPLANATION OF PLATES.

7. How many stars, and of what magnitude, besides the most splendid, are visible during the totality?

8. Are the prominences visible to the naked eye?

9. What is the color and form of the corona as seen with the naked eye?

It must be left to the direction of the navigator which of the above observations, he in accordance with the means in his power will make himself, and which he will distribute among his subordinates.

Lastly, it is desirable for each observer to note—

a. The longitude and latitude in which the observations have been made.

d. Whether the telescope inverts or not, as well as its magnifying power.

J. F. JULIUS SCHMIDT,

Astronomer.

ROYAL OBSERVATORY, AT BONN, PRUSSIA, *Feb.* 19, 1853."

Passages to California Reviewed.

The last mail from California brought me the abstract logs of the "Wild Pigeon," Captain Putnam; of the "John Gilpin," Captain Doane; of the "Flying Fish," Captain Nickels; and of the "Trade Wind," Captain Webber—all clipper ships, ably commanded, and navigated most admirably.

The tracks of these ships are capital illustrations, of what ship masters may gain by recollecting that the information which the *Wind and Current* Charts spread before them, is not of my teaching, or that of any one person; that it is worth more than the experience of any single navigator, for it is the experience of thousands, expressed in lessons of easy comprehension.

Moreover, these abstract logs furnish accounts of a race, in which each ship being put upon her mettle, was driven at her topmost speed, the one almost in hail of the other, for three months over a course of 15,000 miles in length.

All sailed from New York, in the autumn of 1852. The "Wild Pigeon," October 12th; the "John Gilpin," October 29th; the "Flying Fish," November 1st; and the "Trade Wind," November 14th. Each one was provided with the Wind and Current Charts. Each one had evidently studied them attentively; and each one was resolved to make the most of them, and do his best. All ran against time; but the "John Gilpin" and the "Flying Fish" for the whole course, and the "Wild Pigeon" for part of it, ran neck and neck, the one against the other, and each against all. It was a sweep-stake with these ships, around Cape Horn and through both hemispheres.

"Wild Pigeon" led the other two out of New York, the one by seventeen, the other by twenty days. But luck and the chances of the winds seem to have been against her from the start. As soon as she had taken her departure, she fell into a streak of baffling winds, and then into a gale, which she fought against and contended with for a week, making but little progress the while; she then had a time of it in crossing the "Horse Latitudes." After having been nineteen days out, she had logged no less than thirteen of them as days of calms and

baffling winds; these had brought her no further on her way than the parallel of 26° N. Thence she had a fine run to the Line, crossing it between 33° and 34° W., the thirty-second day out. She was unavoidably forced to cross it so far west: for two days before, she crossed 5° N., in 30°—an excellent position.

In proof that the "Pigeon" had accomplished all that skill could do and the chances against her would permit, we have the testimony of the barque "Hazard," Capt. Pollard. This vessel being bound to Rio at the same time, followed close after the "Pigeon." The "Hazard" is an old hand with the charts; she had already made six voyages to Rio, with them for her guide. This was the longest of the six, the mean of which was twenty-six and a half days. She crossed the Line this time in 34° 30′, also by compulsion, having crossed 5° N. in 31°. But the fourth day after crossing the equator, she was clear of Cape St. Roque, while the "Pigeon" cleared it in three days.

So far, therefore, chances had turned up against the "Pigeon," in spite of the skill displayed by Putnam as a navigator, for the "Gilpin" and the "Fish" came booming along, not under better management, but with a better run of luck and fairer courses before them. In this stretch they gained upon her:—the "Gilpin" seven and the "Fish" ten days; so that now the Abstract Logs showed the "Pigeon" to be but ten days ahead.

Evidently the "Fish" was most confident that she had the heels of her competitors; she felt her strength; was most anxious for a quick run; and eager with all, for a trial. She dashed down southwardly from Sandy Hook, looking occasionally at the charts; but, feeling proud in her sweep of wing, and trusting confidently in the judgment of her master, she kept on the average two hundred miles to leeward of the right track. Rejoicing in her many noble and fine qualities, she spread her wings to the utmost stretch, trusting quite as much in her sails as in the charts, and performed the extraordinary feat of bounding, the sixteenth day out from New York, across the parallel of 5° N.

The next day she was well south of 4°, and in the "Doldrums," long. 34°.

Now her heels became paralysed, for fortune seems to have deserted her awhile, at least her master as the winds failed him feared so; they gave him his motive power; they were fickle, and he was helplessly baffled by them. The bugbear of a northwest current off Cape St. Roque looked alarming; then the dread of falling to leeward, and the chance of finding his fine ship back-strapped, filled the mind of Nickels with evil forebodings and shook his faith in his guide.

The sailing directions had cautioned the navigator again and again not to attempt to fan along to the Eastward in the equatorial "Doldrums," for by so doing he would find himself engaged in a fruitless strife, with baffling airs, sometimes reinforced in their weakness by westerly currents. But the winds had failed, and so too he evidently thought had the Sailing Directions.

If there be a breeze, and if it be fair, for making easting in the "Doldrums," and if the navigator be too far West, of course he should then make easting. But if the airs be light and baffling, the vessel will only continue the longer in the "Doldrums," by steering East or West, for then she runs along with the calm belt. But by steering North or South she goes straight across it, and in the least time possible.

After passing it, and getting with a rising barometer the S. E. trades, and finding them, as is often the case, at S. S. E., then the navigator having a breeze, can make Easting. At any rate it is better to attempt to make Easting by beating against the S. E. trades, than by fanning along with light airs and calms, in the "Doldrums." Therefore, the Sailing Directions advised him to dash right across this calm streak, stand boldly on, take advantage of slants in the wind, and by this device, make Easting enough to clear the land. So, forgetting that the charts are founded on the experience of great numbers who had gone before him, Nickels being tempted, turned a deaf ear to the caution, and flung away three whole days and more, of most precious time, dallying in the "Doldrums."

He spent four days about the parallel of 3° N., and his ship left the "Doldrums," after this waste of time, nearly upon the same meridian at which she entered them.

She was still in 34°, the current keeping her back, just as fast as she could fan East. After so great a loss, her very clever master, doubting his own judgment, became sensible of his error, and leaving the spell bound calms behind him, entered in his log as follows :—"I now regret, that after making so fine a run to 5° N., that I did not dash on, and work my way to windward to the northward of St. Roque, as I have experienced little or no westerly set since passing the equator, whilst three or four days have been lost in working to the Eastward, between the latitude of 5° and 3° N. against a strong westerly set;" and he might have added, "with little or no wind."

In three days after this, he was clear of St. Roque. Just five days before him the "Hazard" had passed exactly in the same place, and gained two days on the "Fish" by cutting straight across the "Doldrums," as the sailing directions advised him to do.

The "Wild Pigeon" crossing the equator also in 33°, had passed along there, 10 days before, as did also the "Trade Wind," 12 days after. She crossed the Line also to the West of 34°, and in four days after had cleared St. Roque, which certainly is a great deal better than stopping in the "Doldrums" to fight with baffling airs.

But, notwithstanding this loss of three days by the "Fish," who so deeply regretted the mistake, and who afterwards so handsomely retrieved herself, she found herself on the 24th November alongside of the "Gilpin," her competitor. They were then both upon the parallel of 5° South, the "Gilpin" being 37 miles to the Eastward, and of course in a better position, for the "Fish" had yet to take advantage of slants, and stand off shore to clear the land.

The charts showed the "Gilpin" now to be in the best position, and the subsequent events proved the charts to be right, for thence to 53° S. the "Gilpin" gained on the "Pigeon" two days, and the "Pigeon" on the "Fish" one.

But the "Pigeon" and the "Fish" dashed through the straits of Le Maire; the "Gilpin" going around. For the benefit of those who follow in this route, I quote the Le Maire passages of both :

From the "Wild Pigeon's" Log.

"Straits of Le Maire, Lat. 54° 48′ S.; Long. 64° 45′ W.; barometer 28.90, thermometer (air) 45°; surface

water, 42° ; wind, first part, W. S.W. ; middle part, N. W. ; last part, calm. It was now near noon, and we were becalmed, and had some difficulty in keeping clear of the "Realm ;" the tide was now setting strong to the S. W. I did not expect this, for I had an impression that it always set through to the Northward. I have now no doubt of their being regular tides through these straits, and no one should despair of a passage through. The tide rips, races and whirlpools, are ugly looking customers—quite equal to those of the Pentland Frith, in Scotland. These Straits should be surveyed by one of our Government vessels, for I have no doubt if the shores were well known and by keeping close in, an eddy would be found, that would help a vessel through, even with the tide against her, in the middle of the Straits. On entering these Straits I should keep well over towards the western shore, the wind being off, that is to say, from the westward. The "Realm" being 6 miles astern, when the wind hauled to S. W., could not keep so far to windward ; the tide was now strong against us, but was with the "Realm," for she passed us rapidly about 3 miles to the leeward, and went ahead of us 4 miles ; between the two ships, there was a race or tide rip that fairly roared and extended North and South as far as the eye could reach ; it had the appearance of a strong tide over rocks. Seeing the "Realm" had a fair tide, and we a head one, I bore up and crossed the race to the leeward ; in crossing it we were shaken violently and whirled around in spite of helm and sails by rapid whirlpools. However, we had no sooner crossed the race than we had a change in the tide, and we were soon up with the "Realm."

December 13, at noon, lat. 56° 27′ S., long. 65° 45′ W., current one mile per hour, easterly ; barometer 28.60 ; thermometer (air) 42° ; surface of the water 41° ; winds : during first part, north ; middle part N. W. ; latter part N. W. Light winds and very squally bad looking weather. At 10 p. m. had a white squall, shortened sail, was obliged to keep before the wind to save our sails, being caught with royal and studding-sails out, lost no spars, but had some sails blown to pieces. This is the first white squall I ever saw and felt, and I have been to sea for thirty years and upwards.

December 14, at noon, lat. 56° 28′ S., long. 66° 44′ W ; barometer 28.40 ; thermometer (air) 39° ; surface of water, 41° ; winds : during first part N. W., variable ; middle part S. S. E. ; latter part S. W. ; moderate and doubtful looking weather. At 5 had a heavy squall from the westward with snow and hail. Middle part a gale from the south and a large sea making ; ship under snug sail. At 4 a. m. thick rains and stormy ; made Cape Horn under our lee, having been set in by the tide at the rate of one and a quarter mile per hour. Ends with a bad gale from the S. W. and a heavy rolling sea ; ship under close reefs.

December 15, at noon, lat. 56° 52′ S., long. 66° 52′ W., current per hour one and half mile, easterly ; barometer 28.80 ; thermometer (air) 38° ; surface of water 40° ; wind : first part S. W. ; middle part, S. S. W. ; latter part S. E. ; first part hard gale from the S. W. ; second part blowing in furious gusts ; third part, moderating fast, all sail set at noon."

From the Log of the "Flying Fish."

"December 20, 1852, lat. 54° 56′ S., long. 65° 7′ W. ; barometer 29.50 ; temperature at 9 a. m. 47° ; water 46° ; wind : first part, S. W. ; middle part, S. S. W. to W. ; last part, westerly.

First part, fresh winds and clear weather; middle, wind increasing and thickening up in the westward. Last part, wind died away, cloudy weather, wind hauled to westward, gentle breezes, made the land: entrance of Straits of Le Maire.

December 21, lat. 55° 16′ S., long.—; barometer—; temperature (air) at 9 a. m. 52°; water 45°; wind: first part, southward; middle part, easterly; last part, northerly.

4 p. m., wind hauled to eastward and freshened; 5 p. m., tacked ship off Cape Diego to the N. E.; 6 p. m. tacked ship to southward and stood in through Straits of Le Maire; strong flood against us until midnight. Middle part, wind died away to a flat calm; latter part, light southerly airs and baffling. In the straits passed a brig showing Danish colors. A fore-and-aft schooner and a brig in sight. West end of Staten Land bearing N. by W. true; distance 28 miles.

December 22, lat. 56° 6′ S., long.—; barometer—; temperature (air)—; water—; wind: first part, N. W. to N. E.; middle part, N. E.; last part, N. E.

First part, light baffling winds, and hazy weather; middle part, freshened from N. E. with fog; last part ditto. Meridian, passed Cape Horn bearing N. half E., distance seven miles."

By dashing through the straits, the "Fish" gained three days on the "Gilpin;" but here, fortune again deserted the "Pigeon," or rather the winds turned against her; for as she appeared upon the parallel of Cape Horn and was about to double round, a westerly gale struck her and kept her at bay for ten days, making little or no way, except alternately fighting in a calm or buffeting with a gale, while her pursuers were coming up "hand over fist" with fine winds and flowing sheets.

They finally overtook her, bringing along with them propitious gales, when all three swept past the Cape and crossed the parallel of 51° South, on the other side of "the Horn;" the "Fish" and the "Pigeon" one day ahead of the "Gilpin."

The "Pigeon" was now, according the charts, in the best position, for she was in 85° W.; the "Gilpin" next, in 84°; and the "Fish" last, in 79°; but all were doing well.

From this parallel to the S. E. trades of the Pacific, the prevailing winds are from the N. W. The position of the "Fish," therefore, did not seem as good as the others, because she did not have the sea room in case of an obstinate N. W. gale.

But the winds favored her. On the 30th Dec. the three ships crossed the parallel of 35° S., the "Fish" recognizing the "Pigeon;" the Pigeon saw only a "clipper ship," for she could not conceive how the ship in sight could possibly be the "Flying Fish," as that vessel was not to leave New York for some three weeks after she did; the "Gilpin" was only 30 or 40 miles off at the same time.

The race was now wing and wing, and had become exciting. With fair winds and an open sea, the competitors had now a clear stretch to the Equator of two thousand five hundred miles before them.

The "Flying Fish" led the way, the "Wild Pigeon" pressing her hard, and both dropping the "Gilpin" quite rapidly.

The two foremost reached the Equator on the 13th January, the "Fish" leading just 25 miles and

crossing in 112° 17';* the "Pigeon" 40 miles further to the east. At this time the "John Gilpin" had dropped 260 miles astern.

Here Putnam of the "Pigeon" again displayed his tact as a navigator, and again the fickle winds turned against him. The belt of N. E. trades had yet to be passed; it was winter; and by crossing where she did, she would have an opportunity of making a fair wind of them, without being much to the west of her port when she should lose them. Moreover, it was exactly one year since she had passed this way before; she then crossed in 109°, and had a capital run of 17 days to San Francisco.

Why should she not cross here again? She saw that the 4th Edition of sailing directions which she had on board, did not discountenance it, and her own experience approved it. Could she have imagined that in consequence of this difference of 40 miles in the crossing of the Equator, and of the two hours time behind her competitor, she would fall into a streak of wind which would enable the "Fish" to lead her into port one whole week? Certainly it was nothing but what sailors call "a streak of ill luck" that could have made such a difference.

But by this time "John Gilpin" had got his mettle up again. He crossed the line in 116°;—exactly two days after the other two—and made the glorious run of 15 days thence to the pilot grounds of San Francisco.

Thus end the abstract logs of this exciting race, and these remarkable passages.

The "Flying Fish" beat: she made the passage in 92 days and 4 hours from port to anchor; the "Gilpin" in 93 days and 20 hours from port to pilot;† the "Wild Pigeon" had 118. The "Trade Wind" followed, with 102 days, having taken fire and burned for 8 hours on the way.

The result of this race may be taken as an illustration as to how well the winds and the currents of the sea are now coming to be understood.

Here are three ships sailing on different days, bound over a trackless waste of ocean for some 15,000 miles or more, and depending on the fickle winds of heaven, as they are called, to waft them along; yet like travelers on the land bound along the same road, they pass and repass, fall in with and recognize each other by the way; and what perhaps is still more remarkable, is the fact that these ships should each, throughout that great distance and under the wonderful vicissitudes of climates, winds and currents which they encountered, have been so skilfully navigated, that in looking back at their management, now that what is passed is before me, I do not find a single occasion on which they could have been better handled except in the single instance of the "Flying Fish" while crossing the "Doldrums" in the Atlantic. And this mistake her own master was prompt to discover, and quick to correct.

It is rare and deserving of note and commendation too, to find any ship so well navigated on such a long voyage, and through such a variety of scenes, that, if it were to do over again, no departure from the course actually pursued could be made for the better, except that very pardonable—because so natural—mistake of

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*Twenty-five days after that, the "Trade Wind" clipper came along, crossed in 112°, and had a passage of 16 days thence into San Francisco.

† The abstract log of the "Gilpin" is silent after the pilot came on board.

the "Flying Fish" before alluded to. But for that one mistake, her passage to California would probably have been the shortest on record.

This mistake is common among navigators. But one in crossing the equator as far as 35° W. is not hopelessly too far west; and even then he had better go straight across the "Doldrums," trusting to luck for slants, than attempt to make easting in those calm places. Twelve days after the "Flying Fish" had crossed the equator, in the Atlantic, which she did in 34° 30′, the "Trade Wind" came along and crossed it in 34° 10′ with the wind S.S.E. Of course, she could have made an east course on the starboard track, but she took fire, burned for eight hours, and was in imminent danger of being destroyed. During this time she lost a degree of longitude by falling that much to the westward. Notwithstanding all this, she was only six days from the Line to 9° S., which cleared her of everything. But for the fire, her passage to California would probably have been less than one hundred days.

There is another circumstance which I have observed, and which is worthy of notice in this connexion, as illustrative of the accuracy of the knowledge which the investigations upon which these charts are based, afford concerning the force, set and direction both of winds and currents, and it is this:

In calculating the best routes for the different months, pp. 347, *et seq.* I have calculated also the distance which a vessel undertaking to follow these routes, would have to accomplish, on account of detour caused by head winds, &c. On this occasion, only the "John Gilpin" and the "Hazard" entered the distance by log from New York to the Line. The distance which, according to the sailing directions, each vessel would, at that season of the year, after allowing for the deviations which head winds would require her to make from the straight course, have to sail to reach the equator, is 4,115 miles. The "Gilpin" actually logged 4,099, the "Hazard" 4,077. Thus accomplishing in the year 1852, the voyage by sailing, the one within 38, the other within 16 miles, of the distance which by calculation in 1849, it was predicted they would have to accomplish.

All the maritime nations of the world have been invited by the United States Government to co-operate with us in making observations at sea, according to an uniform plan, and in keeping abstract logs for the Wind and Current Charts; and with the view of enlisting the services of private shipmasters, under foreign flags, in his undertaking, I am authorized by Mr. Dobbin, the Secretary of the Navy, to place the merchant service of all friendly nations upon the same footing with regard to the Wind and Current Charts, which American shipmasters occupy. That is, any merchant captain, whatever be the flag he sails under, who will agree to keep and furnish an abstract log of *every voyage* according to the form prescribed at pp. 486–487, and on the terms set forth at p. 485 of this work, will be furnished therefor, with a copy of these Sailing Directions and of such sheets of the charts as relate to his cruising ground.

Therefore, before applying for the charts, each master should furnish himself with *at least* one good chronometer, one good sextant, two good steering compasses, a marine barometer and three air and water thermometers. I say *at least,* because this is the smallest outfit of instruments that can enable the navigator properly to perform his part of the agreement.

NATIONAL OBSERVATORY, 5*th April*, 1853.

More about the Australian and other passages in the Pacific—vide pp. 464, etc.

vide pp. 464, etc.

The United States and Australia are antipodal. A diameter of the earth having one end in the Atlantic upon the parallel of 38° N. at its intersection with the meridian of 35° W. would have the other near Port Philip, New South Wales. It will therefore be perceived how that the meridians of many places in America being followed to the South Pole, and thence onward, would guide one to various places in New Holland.

Thus the same meridian line which passes through Eastport in Maine, being continued on the other side of the world, will be found to pass near the Swan river settlement of the great Gold Continent.

This meridian is a great circle, and it therefore represents the shortest distance between any two places that are situated upon it.

Hence it will be perceived that the great circle from New York to Australia passes very nearly through the axis of South America, thence south through the Antarctic regions, and so on northwardly again till it reaches this modern Ophir.

But this route is impracticable to the navigator, and it is therefore useless to give him sailing directions for it.

Let us, however, look for one which being practicable will be found to deviate as little as possible from the great circle, and which, moreover, all things being considered, offers to vessels in the Australian trade from Europe as well as from the United States, the fairest prospect of the most speedy passages. Having found such a route, I propose to give those navigators, whether American or European, who are coöperating with me in collecting data for my researches, the benefit of additional sailing directions for Australia, or at least such further suggestions with regard to the passage as I at present feel prepared to make.

As the great circle from New York to Port Philip passes through South America, and as the land blocks the way so that ships cannot go west of that meridian, we must look to the eastward of it for the most practicable route.

Cape St. Roque and Port Philip may be considered for all our present purposes to be actually, as in reality they nearly are, on the same meridian. To find the great circle distance between two such places, we have but to add the co-latitude of one to the co-latitude of the other, and their sum gives what is sought. Thus the co-latitude of the St. Roque is 84° 32′, and of Port Philip 51° 41′, the sum of which is 136° 13′.

It will suit the purposes of illustration better to count from the equator in the Atlantic at its intersection with the meridian of St. Roque (35° 24′) from which point the great circle distance to Australia is 8,501 miles.

Now all ships, whether from North America or Europe that are bound into the southern hemisphere are advised to cross the line to the eastward of 35° 24′, (west.) Therefore this great circle is not yet far enough to the eastward for the navigator. Suppose, then, the average crossing place in the Atlantic to be, as it nearly is, in 30° west: let us start the great circle from this point. From this crossing to Port Philip, the most remote parallel touched by the great circle, is about 84° S. near its intersection with the meridian of 60° E., and the distance to Australia is 8,482 miles.

"Here, then, is a ship under canvass, and with the winds alone as a propelling power, and with a crew, too, so short, the captain informs me, that she was but half manned, accomplishing, in twenty-two days, the enormous run of six thousand two hundred and forty-five miles, (one-fourth the distance round the earth,) and making the daily average of two-hundred and eighty-three statute miles and nine-tenths (283.9). During eleven of these days consecutively, her daily average was three hundred and fifty-four statute miles; and during four days, also, consecutively, she averaged as high as three hundred and ninety-eight and three quarter statute miles.

"From noon of one to the noon of the next day, the greatest distance made was three hundred and sixty-two knots, or four hundred and nineteen miles, and the greatest rate reported by the captain, is eighteen knots, or twenty-one statute miles the hour. This is pretty fair railroad speed.

"The greatest distance ever before performed from noon to noon on the ocean, was 374 knots, (433¼ statute miles,) by the clipper ship "Flying Cloud," in her celebrated passage of eighty-nine days and twenty-one hours, to San Francisco, in 1851, and which yet stands unequalled.* I say from *noon* to *noon*, because from noon to noon was not, with either of these ships, the exact measure of twenty-four hours. The "Flying Cloud" was going to the northward and westward, and on the day of her great run she made four degrees forty-six minutes of longitude—which in time, is nineteen minutes four seconds—that is, her noon to noon for that day was twenty-four hours, nineteen minutes, four seconds. On the other hand, the "Sovereign of the Seas" was steering to the eastward, and on the day of her great run, she made eight degrees, forty-four minutes of longitude—which in time is thirty-four minutes, fifty-six seconds—that is, her noon to noon for that day, was only twenty-three hours, twenty-five minutes, four seconds long. Thus the "Flying Cloud's" run in twenty-four hours, nineteen minutes, four seconds, was 433¼ statute miles; and the other, 419 statute miles in twenty-three hours, twenty-five minutes, four seconds.

"Reducing these runs each to the performance pro rata according to the log, for twenty four hours, we have for the former ship 427.5, against 437.6 by the latter—that is, the best twenty-four consecutive hours run by the "Sovereign of the Seas," exceeds the best consecutive twenty-four hours of the "Flying Cloud," only by the *one-tenth part of one mile*. These two ships are certainly *par nobile*—but the great day's performance of each does not prove the "Sovereign of the Seas" to be a faster ship than the "Flying Cloud."

* NOTE.—Since this was written I have received from the owners a copy of the Abstract Log of the ship "N. B. Palmer," (Charles P. Low,) from New York to San Francisco, in 1852, and which abstract, this letter has called forth. Never having seen or heard of it before, I extract as follows:

"May 25th, 1852. Lat. 37° 46', Long. 61° 20' W.; distance 220 miles; strong breeze, high head sea.

"May 26th. Lat. 36° 32', Long. 53° 10'; distance 390 miles; stiff breeze thoughout the day, made 390 miles in 24 hours."

This ship was steering to the eastward, but it appears by the above quoted positions on the 25th and 26th, that her distance was 397—not 390 miles—from noon to noon, which in her case, was 23h., 27m., and 20s.; for her difference of longitude in time consequent upon this day's run was 32m. 40s. Now, according to her distance of the previons day, she went at the rate of 5 miles in 32m. 40s., which according to this abstract, gives that ship the enormous distance of 402 nautical miles, or 465 statute miles and 6 tenths in 24 hours!

It is very desirable that shipmasters who are co-operating with me should, when they record such enormous days' runs, report as to particulars. I will be obliged to them, therefore, whenever their run exceeds 300 miles a day, if they would send me not only a transcript from the Log-slate, of the courses and distances for that day, but a copy also of the sights both for Long. and Lat., by which the place of the ship was established for the day previous, the day of, and the day after, the great run. In sending the sights, they should not forget to state error and rate of Chronometer.

"The "Sovereign of the Seas" had in her favor that long, rolling swell from the westward, that is peculiar to high southern latitudes, and which helped mightily to heave her along. All seamen who have doubled Cape Horn know what it is; I need not describe it.

"It is true the "Flying Cloud" on her great day, had, "during the latter part, strong gales and high seas running;" still those "high seas" were not like that long rolling Cape Horn swell that comes from the westward with such a heaving force, and which had been chasing the "Sovereign of the Seas" steadily for ten days.

"On the other hand, it may be urged in favor of the latter, that she was short handed, and deeply laden, with foretopmast disabled, and jury topgallant mast. Her abstract log, it should also be mentioned, says nothing as to the force of the wind, the heave of the sea, or the sails set, while that of the "Flying Cloud" is quite full upon these points.

"Through I am unwilling, therefore, to decide against the "Flying Cloud" as to the greatest day's run ever made, it is clear that her competitor has borne off the palm as to the length of time for which she has kept up her great speed. Her log stops May 3d, latitude 35 deg. 16 min. N., 432 nautical miles in a straight line from Sandy Hook.

"Taking it therefore for the seventy-nine days for which she gives it, and stating the distance by straight line from her place at noon of one day to the noon of the next, it appears that her daily average was 227 statute miles, making the whole distance sailed during the interval to be 17,597 statute miles, which gives for canvass the remarkable achievement of accomplishing a distance more than two-thirds of that which it requires to encircle the earth, at the average rate of nine miles and upwards the hour for 1,896 consecutive hours.

"As I write this, the abstract of another ship, the "Comet," E.C. Gardner, from San Francisco to New York, is received. She, too, has made an extraordinary run. She made the passage in 83½ days, sailing during the interval 17.496 statue miles, and averaging 210 miles a day. She, however, except merely by doubling Cape Horn, did not run through the region of the trade like winds and heaving swells of the South Pacific, which favored the "Sovereign of the Seas" to such an extent; and therefore no fair comparison can be made as to the relative sailing qualities of these two ships." * * *

"But the "Flying Dutchman," Capt Hubbard, held her a beautiful race. This is a clipper, and sailing one day only before the "Comet," had a run of 84 days from San Francisco to the offings of New York.

"In 38 days from port, she doubled the Cape. She did not get regularly into the famous N. W. trades of the southern hemisphere until she reached the parallel of 50° S.; She then flew with them around the Cape, and carried them to 34° in the South Atlantic as per the following extract from her log:

"March 19th, 1853. Lat. at noon 51° 10′ S; Long. at do. 85° 09′ W.; bar. 30.2; ther., air 51°, water 48°; wind (for three parts of the day) N. N. W., N. W., N. W. Fresh breezes and cloudy.

"March 20th. Lat. 53° 53′ S.; Long. 79° 03′ W.; bar. 30.00; ther., air 50°, water 47°; wind (for the three parts of the day,) N. N. W., N. W., N. W. Fresh breezes and cloudy.

"March 21st. Lat. 56° 25′ S., Long. 72° 13′ W.; bar. 29.65; ther. air 48°, water 44°; wind, for the three parts of the day, N. W., N. W., N. W.; fresh breezes, and cloudy.

"March 22d. Lat. 56° 40′ S; Long. 64° 18′ W.; bar. 29.60; ther., air 45°, water 44°, wind (for the three parts of the day,) N. W., N. W., N. W. First and middle part fresh breezes, north, rain; last part moderate.

"March 23d. Lat. 55° 17′ S; Long. 58° 25′ W; bar. 29.70; ther., air 44°; wind (for the three parts of the day,) W. S. W., N.W., N. N. W.; First and middle part moderate winds and clear, last part foggy, with fresh breezes.

"March 24th. Lat. 55° 52′ S., Long. 52° 42′ W.; bar. 29.70; ther., air 45°, water 43°; wind (for the three parts of the day,) W. N. W., N. W., N. W. First part fresh breezes and squally with rain and foggy. Many whales in sight. Middle and last part moderate.

"March 25th. Lat. 51° 06′ S., Long. 47° 12′ W.; bar. 29.85; ther., air 46°, water 41°; wind (for the three parts of the day,) N. W., W. N.W., West. First and middle parts moderate wind and variable with fog. Latter part light winds and cloudy.

"March 26th. Lat. 49° 39′ S., Long. 43° 29′ W.; bar. 29.95; ther., air 43°, water 42°; wind (for the three parts of the day,) W. N. W., W. N. W., S. W. Moderate winds and fog all these 24 hours.

"March 27th. Lat. 48° 04′ S., Long. 38° 05′ W.; bar. 29.85; ther., air 50°, water 59°; wind (for the three parts of the day,) N. by W., N. W., N. W. First part moderate winds and cloudy, middle and last parts fresh.

"March 28th. Lat. 48° 35′ S., Long. 33° 04′ W; bar. 29.90; ther., air 48°, water 45°; wind (for the three parts of the day,) N. W., N. W., N. W. by W. Strong breezes and cloudy these 24 hours. An E. S. E. sea running.

"March 29th. Lat. 40° 38′ S; Long. 30° 07′ W.; bar. 30.00; ther. air 56°, water 57°: winds for the three parts of the day, N. N. W., N. W., N. W: fresh breezes and cloudy all these 24 hours.

"March 30. Lat. 38° 12′ S., 26° 14′ W.; bar. 30.17; ther. air 65°, water 62°: wind, three parts, N. by W., N. and N. E.; moderate winds, unsteady with strong puffs.

"March 31st. Lat. 37° 36′; 27° 46′ W.; bar. 30.02; ther., air 64°; water 62°: wind, three parts, N. by W., N. W., N. W. by N.: fresh breezes, and unsteady with rain.

"April 1st. Lat. 35° 24′ S., 25° 24′ W.; bar. 30.15; ther., air 66°, water 65°: wind, throughout N. N. W.: first part, fresh breezes and squally with rain; rest moderate and clear.

"April 2d. Lat. 34° 21′ S., 24° 25′ W.; bar. 30.17; temp. air 72°; water 70°. Winds, the three parts, N. N. by W., N.; moderate breezes, and unsteady.

"April 3d. Lat. 32° 58′ S., 26° 34′; bar. 30.08; temp. air 69°; water 69°; winds, the three parts, N., N. by E., N. N. W; first part, fresh breezes and cloudy; middle, moderate and clear; latter part, foggy."

She did not clear the "Horse Latitudes" in which she now found herself, until the 6th, when she reached the parallel of 29°. She then took the winds with easting in them.

The "Comet," Capt. E. C. Gardner, which sailed from San Francisco the day after the "Dutchman," reached the region of these winds in the Pacific, 33 days out in 50° south, and also carried them as per extract from her log:

"March 18th. Lat. 49° 50′ S.; Long 98° 45′ W.; bar. 29.75; water 47°, air 55°. Winds, first part N. E.; middle and latter parts, North. Strong breezes and overcast weather, with light rain and thick mist.

"March 19th. Lat. 53° 05′ S., Long. 94° 45′ W.; bar. 29.68; air 54°, water 46°; wind (for the three parts,) N., N. W., N. W. Brisk breezes, and overcast weather with light rain and thick mist.

"March 20th. Lat. 54° 20′ S., Long. 89° 40′ W.; bar. 29.32; air 48°, water 44°; winds (for the three parts,) North, N. N. E. variable. Brisk and moderate, first and middle good weather, latter rainy and variable.

"March 21st. Lat. 56° 45′ S.; Long. 83° 20′ W.; bar. 29.15; air 48°; water 44°: wind, for the three parts, N. E. N., N. W: brisk breezes and variable weather, mist, fog, rain, &c., &c.

"March 22d. Lat. 58° 50′ S; Long. 75° 35′ W; bar. 29.18; air 46°; water 42°: wind thoughout N.W: strong gales, with some very good, and some very bad weather; bar., at 12 M., 28.98.

"March 23d. Lat. 58° 40′ S.; Long. 66° 30′ W.; bar. 29.25; air 46°, water 40°; wind thoughout N. W.: strong breezes and good weather; ends rainy.

"March 24th. Lat. 57° 03′ S.; Long. 60° 15′ W.; bar. 29.26; air 45°, water 41°: wind thoughout N. W.; variable weather, from royals to double reefs.

"March 25th. Lat. 54° 40′ S.; Long. 53° 50′ W.; bar. 29.57; air 43°; water 42°: winds thoughout N. W., strong breezes, and plenty of fog, some fine weather, smooth sea.

"March 26th. Lat. 53° 00′ S.; Long. 49° 35′ W.; bar. 29.40; air 44°, water 41°; winds thoughout N. W.; strong gales and thick weather.

"March 27th. Lat. 51° 55′ S.; Long. 46° 40′ W.; bar. 29.55; air 41°; water 40°; winds, for three parts, N. W. and calm: thick dirty weather.

"March 28th. Lat. 49° 30′ S.; Long. 40° 10′ W.; bar. 29.40; air 45°, water 41°: winds, for three parts, N., N. W., and W.; light winds; strong gales; and brisk breezes, with variable weather, ends fine.

"March 29th. Lat. 48° 05′ S; Long. 37° 40 W.; bar. 29.35; air 49°, water 49°: winds, for three parts, W. N. W., N. by W., N. W; moderate breezes, light airs, and strong gales; *fine, thick, rainy.*

"March 30th. Lat. 46° 45′ S.; Long 37° 40′ W.; bar. 29.52; air 53°, water 51°; winds, for the three parts, N. W., S. W., S. W.: heavy gales, and light airs, thick rain and fine weather. *Variety.*

"March 31st. Lat. 46° 10′ S.; Long. 35° 40′ W.; bar. 29.30; air 51°, water 50°: winds, for the three parts, calm, N. N. E., N. W. by N. F. P. Fine weather, latter strong gales and thick weather.

"April 1st. Lat. 44° 20′ S., Long. 33° 55′ W.; bar. 29.45; air 51°, water 49°—winds (for the three parts,) N. N. W., N. N. W., and S. W. F. and M. strong breezes and thick weather—latter light airs and passing fog clouds.

"April 2d. Lat. 43° 35′ S. Long. 33° 55 W.; bar. 29.70; air 49°, water 47°—winds (for the three parts, southeast calm. Light airs and calm with fog, and some fine weather. *A high sea from N. W.*

"April 3d. Lat. 42° 20′ S.; Long. 32° 10′ W.; bar. 29.55; air 53°, water 51°—winds (for the three parts,) calm, North, N. W. Light airs and strong breezes with fine weather.

"April 4th. Lat. 40° 00′ S., Long. 31° 40′ W.: bar. 29.75; air 58°, water 58°—winds (for the three parts,) N. W., West, W. N. W. Strong, moderate and light winds with very variable weather.

"April 5th. Lat. 38° 00′ S., Long. 29° 00′ W.; bar. 29.80; air 61°, water 63°—winds (for the three parts,) West, W. N. W., N. N. W. Light, moderate, and fresh breezes with good weather.

"April 6th. Lat. 36° 39′ S. Long. 28° 13′ W.: bar. 29.82; air 63°, water 65°—winds (for the three parts,) W. N. W., W. and W. S. W. Strong, moderate and light winds, with good weather. *A few squalls.*

"April 7th. Lat. 33° 11′ S., Long. 28° 15′ W.; bar. 29.95; air 66°, water 68°—winds (for the three parts,) West, W. N. W., W. N. W. Light winds and fine weather. A high swell from S. W."

South of the calms of Capricorn, the winds are the same all round the world. Taking them on meridian of the Cape of Good Hope, a fast ship may run with them to the eastward, averaging upwards of 200 miles a day all the way round to Cape Horn.

Capt. McKay in his passage of 82 days in the "Sovereign of the Seas," from the Sandwich Islands to New York, carried the S. E. trades down to the parallel of 45° South. There he found the baffling winds peculiar to the "Horse Latitudes;" after crossing the parallel of 48° he cleared this belt and took the famous westerly winds which wafted him along so finely.

There is warm water—an Australian gulf stream—to be crossed or drifted along with, between Port Philip and Cape Horn. In the paper on the Gulf Stream, which is referred to at p. 55 of this work, the existence of such a body of warm water was theoretically pointed out. The abstract log of the "Sovereign of the Seas" gives me practical proof of its existence, as the following extract will show:

Date.	Lat. S.	Long. W.	Temp. Air.	Temp. Water.
	° ′	° ′	°	°
March 8	47.49	158.30	70	70
9	48.26	156.23	67	65
10	48.25	151.24	65	65
11	48.15	143.44	60	60
12	48.19	136.32	60	62
13	48.40	129.19	40	43
14	48.58	125.00	43	42

Here is a change of 19° in the temperature of the water in one day's run; and from the parallel of 47° 49′ to that of 48° 40′, though the difference of latitude is less than one degree, the difference in the temperature of the water is 28°!

I shall not now stop to investigate the genesis of this warm water and warm current; suffice it for our present purposes to say, it receives its warmth in the equatorial regions, but whether in the Indian ocean, or in the torrid zone of the Pacific, it is immaterial for our present purposes. We know it comes from warmer

latitudes than those in which the "Sovereign of the Seas" found it, and therefore it has southing, and if southing, probably easting also, in its course.

In like manner, the cold water into which this ship ran from the warm, we may, for like reasons, suppose to come from towards the polar regions, and to be bound probably to the coast of Peru, there to feed that remarkable current which was discovered by Humboldt, and which runs up as far as to the Gallapagos Islands, where it probably joins the equatorial current that flows west from the meridian of 100° W. in the torrid zone of the Pacific; and which, taking a sweep down towards the Society Islands, may complete the circuit, and so feed the warm current of which I have been speaking. Is this cold current, in 45° or 50° or 55° South, an ice-bearing current?

Vessels bound around Cape Horn from any of the intertropical islands of the Pacific, should run south through the Trades with topmast-studding sails, make for the trade-like westerly winds of the South Pacific, and with them run down for Cape Horn.

"Permit me," says Capt. McKay in his letter, "to suggest to you the necessity of some sailing directions for homeward bound vessels, and especially from the Sandwich Islands.

"A large and extensive carrying trade is opened to our ships, which will last as long as the polar whales are to be had, as very many of the ships refit at the Islands, and send their oil home.

"As to the part of the route from the Islands to the variables but little need be said, only to caution masters against trying to make easting in the trade winds. The variable westerly winds are so positive, and the degrees of longitude so short, that it is a great loss to keep a ship close hauled. Keep to the leeward of all islands in the track, and give her a good full.

"If I had had a full crew, and a ship in full condition, I should have gone farther south on a great circle, and made a shorter run."

And you would have gained by it. Moreover the advice, not to attempt easting in the trades, is good.

I cannot do better, in giving sailing directions for the voyage from the Sandwich Islands to the United States, as Capt. McKay requests me to do, than quote from his abstract log of the "Sovereign of the Seas," the track which that vessel made on her famous run thence to New York. I recommend it as a guide to others.

ABSTRACT LOG OF THE SHIP "SOVEREIGN OF THE SEAS", CAPT. L. McKAY, COMMANDER, BOUND FROM HONOLULU TO NEW YORK, 1853.

Date.	Latitude, at noon.	Longitude, at noon.	Distances.	Bar.	Ther. 9 a.m. Air.	Ther. 9 a.m. Water.	Winds. First part.	Winds. Middle part.	Winds. Latter part.	Remarks.
		W.	Naut. miles.							
Feb. 12										Laid off and on for passengers and crew.
13	19°06′ N.	158°16		30.10	75°	77°	N. E.	N. E.	East.	
14	18 10	159 00	70	30.20	75	77	East.	S. E.	N. E.	
15	16 20	159 43	117	30.05	78	78	East.	E. S. E.	E. S. E.	
16	12 27	160 28	237	30.00	75	76	E. S. E.	E. S. E.	E. by S.	
17	8 13	159 00	268	30.00	77	76	E. by S.	E. by S.	E. N. E.	
18	4 20	157 42	246	30.00	81	79	N. E.	N. E. by E.	E. S. E.	
19	2 40	158 49	120	30.00	80	80	S. E. by E.	S. E.	S. E.	
20	0 47	160 30	151	30.05	82	83	S. E.	S. E.	S. E. by E.	
21	2 37 S.	159 35	211	30.10	85	85	E. N. E.	E. N. E.	E. N. E.	
22	5 47	159 38	197	30.10	85	83	E. by N.	E. by N.	E. by N.	
23	8 32	160 03	167	30.00	87	85	East.	East.	East.	
24	9 22	160 11	51	29.95	89	87	E. S. E.	E. S. E.	E. S. E.	
25	11 44	160 10	142	29.90	85	83	E. N. E.	E. N. E.	E. N. E	
26	16 25	159 54	281	29.94	83	83	Variable.	Variable.	East.	
27	20 42	160 57	264	29.90	78	82	East.	East.	East.	
28	24 31	160 41	230	29.95	84	84	East.	East.	E. N. E.	
Mar. 1	D.R. 27 32	D. R. 159 36	190	29.90	77	80	S. E.	N. E.	N. E.	
2	30 17	159 20	166	29.92	78	78	East.	E. by S.	E. S. E.	
3	32 41	159 40	145	29.87	76	78	S. E. by E.	East.	East.	
4	37 14	161 15	284	29.82	71	72	E. S. E.	E. S. E.	E. S. E.	
5	42 00	D. R. 163 21	302	29.80	70	70	E. S. E.	E. S. E.	E. S. E.	
6	45 04	164 00	186	29.93	70	70	E. S. E.	East.	E. by N.	
7	D.R. 47 05	160 00	206	29.90	70	70	N. E. by E.	N. E. by E.	N. E. by E.	
8	47 49	138 30	75	29.90	70	70	N. E. by E.	N. E. by E.	N. E. by E.	
9	48 26	156 23	93	29.90	67	65	North.	N. W.	N. W.	

Here he was beset for two or three days by the baffling weather of the Horse Latitudes, one day making only 75, the next only 93 miles. He in the mean time, fanning to the eastward between 47° and 48°. On the 9th March, in 48° 30′ S., 156° West, he took these westerly winds, and on the 22d had doubled Cape Horn.

Now when he found himself in these Horse Latitudes, if, instead of fanning along east in this belt, he had stood directly across it to the South, he would probably have got these strong westerly winds which wafted him along with such speed, a day or two sooner than he did, and thus have gained a day in his remarkable run from there home.

He did not get fairly into these westerly winds, it will be observed, until he had crossed the parallel of 48°; and he says of them, in his letter to me of 7th May, 1853:—

"From the Sandwich Islands to Cape Horn we had fine weather; we could not conveniently make a south course to the variables, but fell to the leeward as far as 164° W., and in lat. 48° S., we found westerly winds for the first time, and they were more constant than the *trade winds* usually are, hauling from southwest to northwest, mostly the latter. We saw and passed Staten Land in 47 days from the

Islands, and made several days good run, I think the largest ever made on salt water. The ship deeply laden with oil, and with fore-topmast sprung, in two places (being a temporary one put up on my outward passage,) and only being able to set a single reefed topsail forward, occasionally a fore top gallant sail over it, on a jury top gallant mast. These facts considered, and in addition to these, the fact of having only a half crew or less than half, I feel as though the ship would yet do much more.

I send you the proofs of some of my running, hoping that it may at best contrast favorably with the "Celia," which has now almost a historical character."

ABSTRACT LOG OF THE "SOVEREIGN OF THE SEAS,"—Continued.

Date.	Latitude, at noon.	Longitude, at noon.	Distances.	Bar.	THER. 9 a. m. Air.	THER. 9 a. m. Water.	WINDS. First part.	WINDS. Middle part.	WINDS. Latter part.	REMARKS.
	S.	W.	Naut. miles.							
Mar. 10	48°25′	D. R. 151°24′	158	30.05	65°	65°	N. W.	N. W.	N. W.	
11	48 15	D. R. 143 44	306	30.05	60	60	N. W.	S. W.	S. W.	
12	48 19	136 32	287	29.87	60	62	W. S. W.	W. S. W.	West.	
13	D. R. 48 40	D. R. 129 19	288	28.95	40	43	West.	W. N. W.	W. N. W.	
14	48 58	125 00	172	30.08	43	42	W. N. W.	S. W.	S. W.	
15	48 52	D. R. 118 32	256	29.60	44	44	W. S. W.	W. S. W.	W. N. W.	
16	49 41	109 34	355	29.80	43	44	N. W.	N. W.	N. W.	
17	D. R. 50 22	D. R. 101 22	319	30.15	43	43	N. W.	N. W.	N. W.	
18	D. R. 52 12	D. R. 92 47	341	29.95	46	46	N. W.	N. W.	N. W.	
19	55 18	84 03	362	29.60	47	46	N. W.	N. W.	West.	
20	D. R. 56 18	D. R. 76 58	247	29.72	43	41	N. N. W.	N. N. W.	N. N. W.	
21	D. R. 56 23	D. R. 69 00	270	29.60	47	46	N. W.	N. N. W.	N. W.	
22	55 17	D. R. 64 50	156	29.60	49	47	N. N. W.	N. N. W.	N. N. W.	
23	D. R. 54 37	D. R. 60 38	150	27.70	40	40	N. W.	N. N. W.	N. N. W.	
24	52 44	53 15	286	29.75	45	45	N. N. W.	N. W.	N. W.	
25	D. R. 50 15	D. R. 47 47	252	29.78	50	48	N. N. W.	W. N. W.	N. W.	
26	D. R. 47 53	D. R. 45 44	164	30.00	49	49	W. N. W.	West.	W. N. W.	
27	44 39	43 24	217	29.95	47	47	W. N. W.	W. N. W.	N. W.	
28	41 50	38 30	274	29.95	52	52	N. W.	N. W.	N. W.	
29	39 19	34 20	243	30.10	54	54	N. N. W.	N. N. W.	N. N. W.	
30	37 30	31 18	180	30.00	52	52	North.	North.	N. by E.	
31	35 28	D. R. 29 57	138	29.95	63	63	North	N. N. W.	N. W.	
Apr. 1	34 10	28 11	117	29.90	67	66	N. N. W.	N. W. by N.	N. W. by N.	
2	32 13	30 47	175	30.12	67	67	N. by E.	N. N. E.	N. E.	
3	31 09	29 16	101	30.15	73	73	N. by W.	N. by W.	North.	
4	29 47	27 55	108	30.15	78	78	N. by W.	N. by E.	N. by E.	
5	28 39	27 47	68	30.18	77	77	North.	N. N. E.	N. by E.	
6	27 33	26 49	84	30.15	78	78	N. by E.	N. by E.	N. by E.	
7	26 24	27 12	72	30.12	80	80	South.	N. N. E.	N. N. E.	

This is a very bald log that Capt. McKay has returned, but I have quoted it to illustrate the homeward route from the Sandwich Islands, and in proof also of the regularity of the N. W. winds, which about the parallel of 50° south are found to prevail from the meridian of the Cape of Good Hope around by the East, even to the vicinity of Cape Horn.

Though Captain McKay has been very sparing of his remarks, he has nevertheless hit the best route from the Sandwich Islands to Cape Horn. He made only one mistake by the way and that was in getting from the S. E. Trades through the belt of Horse Latitude weather into the Northwest Trades, I may call them, of the Southern hemisphere.

In passing from one system of Trades to the other, or from the Trades to the variables, there is always a debatable ground which belongs neither to Trades nor variables. This debatable ground between the Trades about the Equator is called the "Doldrums." Between the Trades and the variables of the extra-tropical regions, it is called the "Horse Latitudes."

In these debatable grounds, calms and baffling winds are to be expected, sometimes of several weeks, and often of many days, and occasionally of only a few hours' duration. And the rule for crossing these belts is, whenever there is sea-room, to steer due North or South according to your destination.

Therefore, in coming from the Sandwich or the Society Islands or California, to Cape Horn, the rule should be to go South as fast as possible, in order to get in the N. W. Trade wind region of that ocean with its heaving swells. Until you get into the region of these winds, no course can be given. The best passages are to be made by crossing the Trades with top-mast studding sails set.

And in illustration of this I have but to refer again to the abstract log of the "Sovereign of the Seas," of the "Comet" and the "Flying Dutchman." The two last, though they lost the S. E. trades in about 30°, did not get the regular westerly winds, for some ten days afterwards, near the parallel of 48° or 50°.

All three of these ships were in this debatable ground of Capricorn in the Atlantic, from two to three days; the "Sovereign of the the Seas" making only 68, 84 and 72 miles a day; the "Comet" 27 and 43 miles on two successive days; the "Flying Dutchman" 46 and 104. Indeed it may be said that these ships fell in with the baffling winds of the Horse Latitudes 3d April, when they lost the N. W. Trades.

Returning therefore to the route to Australia and thence home via Cape Horn, I beg to impress navigators with the fact that I am not prepared to speak as to the ice that may be expected so low down as the parallel of 55° or 60° south, between the meridian of the Cape of Good Hope and Van Dieman's land; and therefore, navigators who take these Sailing Directions for their guide, must judge for themselves as to dangers from the ice by the route of which I am now treating. Abstract logs are entirely wanting in that region, and I speak on the faith of theoretical deductions as to this route.

A clipper ship well handled and with a good streak of luck in making the run from the United States into the variables of the southern hemisphere, will be able now and then to make the passage to Australia by this route in 55 days if not in less time; but in 55 days it can be accomplished under canvass alone. It used to be a ten months' voyage.

In that trade, clipper ships will be able to set up a strong opposition to steamers; for if we take into account the increased distance that steamers, touching at the Cape of Good Hope and one or two other places for coal, will have to go, together with the delays incident thereto, we shall see that our clipper ships have not much cause to fear that steamers will ever run them off the water in the Australian trade.

As it has been already remarked, Australia and the United States are antipodal; they are about 12000 geographical miles apart, and it is about as near to come via Cape Horn as it is to go via the Cape of Good Hope. The steamers therefore on their return via the Cape of Good Hope have head winds to contend with for that much of the way, whereas the canvass trader returning by Cape Horn has fair winds to go, and fair winds to come from the Cape of Good Hope all the way east even to Cape Horn.

The passage from Cape Horn to the United States is sometimes made from forty to forty-five days; and Cape Horn may be reached under canvass from Port Philip with these westerly winds and long swells and by keeping well to the south in twenty or twenty-five days.

I have great confidence in the existence, regularity and force of these N. W. Trades in the great Southern Ocean, especially on the polar side of 49° or 50°; S.

The opinion may be rash, or the expression of it may seem like a boast, but be what it may, I here venture the prediction that the round voyage from the United States to Port Philip or Hobarton and home again, can be made and will be made under canvass by the route here laid down, in 125 or 130 days; or *less*.

Nay, I go further, for so great is the confidence I have in the propelling power of these westwardly Trades of the extra-tropical South—and venture the opinion that a voyage of circumnavigation can be accomplished by this route in less time than the passage has ever yet been made by clipper ships from New York or Boston to San Francisco.

May 14*th*, 1853.

It will be as well for the navigator who is aiming for a quick passage—and who in these times is not?—to notice how this great circle from the Line in 30° W. runs. It crosses the parallel of 10° S. in 28° 48′ W.; of 20° in 27° 31′ W.; of 30° in 26° 03′ W.; of 40° in 24° 16′ W.; and of 50° in 21° 50′ West, &c.

This route is also impracticable, for it takes one too far south. But it will serve as a guide to another which will enable the navigator to take the nearest route that is practicable.

Vessels that are bound south-eastwardly, after crossing the Line in 30° west, can generally, reach without being pinched by the way, 30° S. between 30° and 35° west. The great circle distance thence to Port Philip is about 6,700 miles. But if a vessel do not go south of 55° S., she cannot accomplish the passage from the parallel of 30° in the South Atlantic in less than 7,400 miles. It will be observed that since a vessel cannot make south-easting in the S. E. trades, that vessels crossing the Line in 30°, or indeed on any other meridian will find themselves generally forced a little to the westward of the great circle to Port Philip from the point of equatorial crossing, be that upon what meridian it may.

The majority of vessels bound around the Cape of Good Hope cross the meridian of 20° W., between the parallels of 30° and 35° S. Here they generally aim to make a course a little to the south of east. But the great circle route to Australia would require them to pass the parallel of 70° S. before crossing this meridian of 20° W. Therefore the course of the Australian-bound vessel between the parallels of 30° and 35° S., so far from being a little to the *south* of east, is only a little to the *east* of south. The two routes go off nearly at right-angles, and therefore Australian bound vessels do not care to make so much easting in the trades as do those vessels that desire either to touch at or double close around the Cape; consequently it is no object with them to hug the trades as close as the Cape or India bound vessels do.

Here, then, as you clear the belt of S. E. trade winds, there is a fork in the routes. The vessel bound to or around the Cape going to the east, but she whose destination is for the gold fields South, should stand on to the southward, not thinking of hauling up to the eastward until she clears the calms of Capricorn, and finds herself well within the region of the trade-like westerly winds of the southern hemisphere.

She may then begin to edge away and to haul up gradually to the eastward, crossing 50° S. in about 10° west, and reaching the parallel of 55° near the meridian of 20° E. Upon this parallel (unless experience shall prove that she may, without inconvenience as to ice and weather, go still farther south, and the farther south the shorter the distance), she should run along till she crosses the meridian of 100° east, when she may begin gradually to edge up for her port, but still keeping to the right of the rhomb-line on her chart that leads to it.

Hence it will be perceived that Australian bound vessels have nothing to do with the Cape of Good Hope; they do not wish to go within scarcely a thousand miles of it.

The best crossing place of 30° south that the S. E. trades will generally allow for the Australian route is about 32° W.—a few degrees more or less.

The great circle from this crossing to Port Philip will give the navigator a very correct idea as to the best course for him to pursue after reaching 30° S. at the crossing above mentioned.

The distance from it to Port Philip is about 6,700 miles, the arc of the great circle crossing the prime meridian between the parallels of 70° and 75° S., the meridian of 55° east between the parallels of 80° and 82° S. Here it reaches its greatest southern declination, and begins then to incline northwardly.

Australia bound vessels, therefore, are advised, after crossing the equator near the meridian of 30° W.—say between 25° and 32°, as the case may be—to run down through the S. E. trades, with topmast-studding-sails set, if they have sea room, aiming to cross 30° south, generally somewhere about 28° or 30° W., and so on, shaping their course after they get the winds steadily from the westward, more and more to the eastward, until they cross the prime meridian to the south of 50°, reaching 55° south in about 20° east. Thence the best course—if ice, &c., will allow—is onward still to the southward of east, not caring to get to the northward again of 55° before reaching 120° E. The highest latitude should be reached between the meridians of 60° and 80° east. The course then is north of east, gradually hauling up more and more to the north as you approach Van Dieman's Land.

Such is the best route to Australia.—The highest degree of south latitude (and as a rule the farther you go south, the shorter the distance) which it may be prudent to touch, depending somewhat on the season of the year and the winds. If the winds are not good and strong, bear south to look for them. In our summer, one will not have to go so far south to look for these winds, as he will in our winter. The shortest passages therefore will probably be made in the southern summer when daylight, the winds, ice and state of the weather are most favorable for reaching high southern latitudes.

Now the first thing that will probably strike the navigator who has not been accustomed to measure on a terrestrial globe the distance between places, will be the fact that the Cape of Good Hope, instead of being a sort of half way station on the road side between Europe or the United States and New Holland, is some thousand miles or more to the northward of the shortest and best route.

And the next thing will be, that the best crossing on the Equator for Australian bound vessels from the United States is not to the eastward, but it is on the same meridian which affords the best crossing for the Rio or Cape Horn bound vessels.

Vessels therefore bound to Australia from the United States should take the Rio route as far as the Equator. Vessels thither bound from Europe, should aim to cross the Equator in about 25°. Farther east would take them where the Equatorial doldrums will prove troublesome; farther west, too far out of the way.

Having crossed the Equator with sea room and a good offing from the shores of Brazil, the best course for all, whether European or American, is, as before stated, to crack on through the S.E. Trades with topmast studding sails set, or at any rate with a clean rap-full.

When these winds fail, as they will do, from 25° S. in *our* summer and fall, to 35° or even 40° in *our* Winter and Spring, and the Australian trader finds himself in the "Horse Latitudes" of the southern hemisphere, his course is then due *South* until he gets beyond them and well into the strong westerly winds of that region.

These winds will be found between the parallels of 45° and 55° generally, but always between 50° and

55° or even farther South, to prevail with great regularity and force; moreover they are accompanied by that long rolling swell which will of itself help a vessel along many miles a day.

Capt. Cave of the "Helena," the only Australian bound log that I have yet received, took these westerly winds in Lat. 32° S., Long. 27° W. and with the exception of two days near the Cape of Good Hope, did not record a wind with easting in it,—but for one day—thence to Port Philip. From the meridian of the Cape in Lat. 39°, he had a run of 27 days to the golden land. He kept along near the parallel of 41° and averaged about 5 degrees of longitude a day.

The "Helena's" log affords a very good illustration as to the mistake which the Australian bound trader is very apt to make by supposing that his route through the South Atlantic lies along the usual track of vessels bound around the Cape of Good Hope. The Australian route is not the Old India route any further than the Polar edge of the S. E. trades.

With the view of illustrating this fact as well as the route, I quote the "Helena's" abstract log from July 15th, taking her up in her greatest longitude West after crossing the Equator, which she did July 4th, longitude 31° 30′ West. She moreover appears to have found the belt of "Horse Latitudes" South, quite broad, for she was in baffling winds from 20° to 27° S., (5 days.)

Abstract Log of the ship "Helena," F. H. Cave, Commander, bound from New York to Port Philip, Australia, 1852.

"July 15th—Lat. 22° 37′ S., Long. 36° 50′ W; winds for the three parts, E. N. E., E. N. E., and E. S. E.; Light, baffling—tacked several times this day—ends with baffling winds from southward; tacked to eastward. Temperatures: air 74°; water 73°.

July 16th—Lat. 23° 44′ S.; Long. 35° 56′ West—winds for the three parts S. S. E.; E. S. E. and East. Light baffling winds; at 12 midnight, tacked to southward—ends light. Temperatures: air 72°; water 70°.

July 17th. Lat. 26° 06′ S. Long. 35° 30′ W.; winds for the three parts E. S. E.; E. S. E., and East. Light winds with a smooth sea and clear weather; saw several sperm whales this day. Temperature: air 72°; water 74°.

July 18th. Lat. 27° 35′; S. Long. 34° 25′ W.; winds for the three parts E.; E. N. E., and N. E. by N. Light winds at the beginning of this day. At 5 P. M. the wind hauled E. N. E. Middle part, moderate winds. Ends the same. Temperatures: air 66°; water 68°.

July 19th. Lat. 29° 52′ S., Long. 31° 32′ W.; winds, for the three parts N. E; N. E., and N. N. E. Fine breezes this 24 hours with clear weather and a smooth sea. Temperatures: air 62°, water 64°.

July 20th. Lat. 32° 15′ S. Long. 27° 39′ W.; winds, for the three parts North, N. N. W., and N.N.W. Strong breezes this 24 hours with cloudy weather. Temperatures: air 60°, water 62°.

July 21st. Lat. 33° 49′ S. Long. 24° 14′; W.; winds, for the three parts, N. N. W., N. W., and W. N. W. Strong breezes with a rough sea. Temperatures: air 57°; water 54°.

July 22d. Lat. 35° 06′, S. Long. 19° 38′, W.; winds during the day W. N. W. Strong breezes with heavy squalls and heavy swell from the Westward. Temperatures: air 57°; water 56°.

July 23d. Lat. 35° 12′, S. Long. 14° 47 W.; winds during the day, West. Begins with strong gales from the westward with a heavy sea; squally. Temperatures: air 56°; water 56°.

July 24th. Lat. 35° 14′, S. Long. 10° 28′ W.; winds during the day, W. by S. Strong gales from westward with heavy squalls and heavy sea. Temperatures: air 56° water 58°."

The course of this clever navigator from July 18th to 24th, proves what I say. The "Helena" was aiming for the usual track around the Cape of Good Hope. She did not take the fork in the route, to which I have alluded; and by so missing her way, she certainly prolonged her passage considerably. She should have run down with the winds on her quarter upon a S. S. E. course or there away, until she got the "Westerly Trades," the northern verge of which she found July 29th; that is, 11 days after losing the S. E. Trades, and near the parallel of 38° South.

"July 25th. Lat. 36° 11′ S., Long. 6° 42′ W.; air 61°, water 56°; winds for the three parts S. W., S. W., and N. N. W. Moderate winds with passing clouds. At 2 A. M. the wind hauled to the Northward. Ends moderate.

July 26th. Lat. 36° 53′ S., Long 2° 35′ W., air 58°, water 55°; winds for the three parts, N. N. W., N. W., and W. N. W. Begins moderate. At 8 P. M. blowing in heavy squalls, furled top-gallant sails and double reefed topsails. At 4 A. M. more moderate, made all sail. Ends squally.

July 27th. Lat. 37° 46′ S., Long. 1° 56′ E., air 56°, water 55°; winds for the three parts, W. N. W. N.; W.; moderate winds. At 3 P. M. blowing in heavy squalls, furled light sails and single reefed. At 7 P. M. out all reefs, set top gallant sails—middle part moderate. Ends the same.

July 28th. Lat. 37° 33′ S.; Long. 6° 00′ E.; air 56°; water 55°; winds W. N. W., throughout; baffling winds with heavy squalls from northward and westward—middle part heavy hail squalls. Ends baffling.

July 29. Lat. 38° 12′ S.; Long. 10° 50′ E.; air 56°; water 56°, winds N. W., by W. throughout; strong gales with heavy squalls. At 9 P. M. single reefed topsails, furled mainsail. At 2 A. M. out reefs and set top-gallant sails. Ends squally.

July 30th. Lat. 38° 24′ S., Long. 15° 12′ E.; air 60°, water 51°; winds W. N. W. throughout. Strong winds from the westward; at 12 midnight, heavy gales; double-reefed topsails; furled mainsail, jib and spanker. Ends more moderate, made all plain sail.

July 31st. Lat. 38° 23′ S., Long. 17° 38′ E., air 60°; water 51°; winds (for the three parts) W.N.W.;

S. S. E.; S. Blowing strong, with heavy squalls. At 4 P. M. light winds, with heavy sea. Middle part squally, with rain. Ends light, with cloudy weather.

August 1st. Lat. 38° 36′ S., Long. 20° 31′ E., air 60°; water 60°; winds (for the three parts) from S. to S. E.; Calm; East. First part light baffling winds, with rain. At 5 P. M. calm; heavy tide rips through the night. At 5 A.M. took a light breeze from the eastward, with drizzling rain. Ends with moderate winds, and a heavy swell from S. S. E.

August 2d. Lat. 39° 12′ S., Long. 23° 34′ E., air 66°; water 65°; winds (for the three parts) E.; N. E.; N. E. to N. Moderate winds from the eastward, with passing clouds. At P. M. the wind hauled to N. E. Ends moderate.

August 3d. Lat. 39° 18′ S., Long. 27° 49′ E., air 62°, water 58°; wind N. throughout. Moderate winds these twenty-four hours, with passing clouds, and a smooth sea.

August 4th. Lat. 40° 07′ S., Long. 32° 48′ E., bar. 29.5; air 60°; water 56°; winds (for the three parts) N.; N. by E.; N. N. E. Begins with moderate winds, with passing clouds. At 4 P. M. strong winds. At 8 P. M. coming on to blow in heavy squalls. At 2 A. M. more moderate. Ends with fine breezes from N. N. E.

August 5th. Lat. 39° 50′ S., Long. 35° 50′ E., bar. 29.95; air 58°; water 56°; winds (for the three parts) N.; S. W.; W. to S. Moderate winds from the northward and eastward. At 3 P. M. calm. At 5 P. M. took a heavy squall from S.W.

August 6th. Sun obscured, bar. 29.69, air 56°, water 54°; winds (for the three parts) N. E. by E.; N. E.; N. N. W. Baffling winds, with rain. At midnight squally. At 4 A. M. more moderate. Ends baffling and squally.

August 7th. Lat. 40° 41′ S., Long. 44° 01′ E.; bar. 29.70; air 54°; water 51°; winds (for the three parts) N. W.; W.; W. Moderate winds, with heavy squalls. At 7 P. M. heavy rain, with thunder and lightning. At 11 P. M. moderate winds from westward, and clearing up. Ends with strong gales from westward, and squally.

August 8th. Lat. 40° 31′ S., Long. 47° 13′ E.; bar. 29.96; air 56°; water 48°; winds (for the three parts) W.; S. W. to W.; N. Strong winds, with passing clouds."

Here she appears to have got regularly into the Westerly Trades. And now it is not difficult to cast back and see how much the clever master of this ship would have gained, if he had had these sailing directions before him; or if on the 18th July, he had stood away a little to the eastward of South, reaching the parallel of 45° somewhere about 25° or 30° West, and then edging up East, but still keeping to the southward.

The nearer the poles the shorter the degrees of longitude.

Ships intending to take this route should be well manned and found, that they may stand the boisterous, rolling, and rough-weather run that may be expected along this route of fair winds.

"August 8th. Lat. 41° 06′ S., Long. 52° 28; barometer 29.80; air 58°; water 54°; winds (for the three parts,) W. N. W., N. W., N. W.—begins moderate. At 4 P. M., strong breezes—middle part the same—ends the same with passing clouds.

August 10th. Lat. 41° 59′ S., Long. 58° 06′ E.; barometer 29.40; air 56°, water 52°; winds (for the three parts,) N. W., N. and N. Begins with strong breezes with passing clouds—middle part strong winds. At 9 A. M., more moderate—ends with strong gales.

August 11th. Lat. 41° 53′ S., Long. 62° 22′ E.; barometer 29.09; air 58°, water 50°; winds (for the three parts,) North, W. N. W., W. N. W. Begins with strong gales with passing clouds. At 4 P. M., blowing in heavy squalls with heavy rains—wind shifting to W. N. W., and blowing in heavy gusts with hail—middle part the same. At 11 A. M., passed several patches of kelp—ends blowing a heavy gale, and high sea.

August 12th. Lat. 41° 5′ S., Long. 67° 09′ E.; barometer 29.20; air 58°, water 50°; winds (for the three parts) W., W. S. W., W. S. W.—blowing a heavy gale with hail squalls—very high sea—ends blowing heavy gale.

August 13th. Lat. 39° 52′ S., Long. 71° 56′ E.; bar. 29.70; air 56°, water 54°; winds (for the three parts,) W. S. W., W. S. W., S. W. Begins with heavy gales—high sea—middle part blowing in heavy hail squalls. Obliged to run off to keep before the sea—ends more moderate.

August 14th. Lat. 39° 57′ S., Long. 76° 46′ E.; bar. 29.80; air 54°, water 52°; winds (for the three parts,) W. S. W., W. S. W., West—fine breezes with passing clouds—sea smooth—middle and latter parts the same.

August 15th. Lat. 40° 01′ S., Long. 81° 33′ E.; bar. 29.50; air 56°, water 52°; winds (for the three parts,) W. N. W., W. and W. Begins moderate. At 4 P. M., strong breezes—middle part the same—ends squally.

August 16th. Lat. 40° 08′ S., Long. 86° 15′ E.; bar. 29.40; air 56°, water 52°; winds (for the three parts,) W. S. W., S. W., W. N. W.—strong breezes with heavy squalls. At 4 P. M., the wind hauled South in a heavy squall—ends with strong gales and squally with a heavy swell from westward.

August 17th. Lat. 39° 50′ S., Long. 90° 30′ E.; bar. 29.20; air 50°, water 51°; winds (for the three parts), W., W. S. W., W. S. W; Heavy gales from the westward; middle part the same; ends with heavy hail squalls, and thunder and lightning.

August 18th. Lat. 39° 30′ S., Long. 94° 58′ E.; bar. 29.30; air 54°, water 50°; winds W. S. W. throughout; comes in with heavy gales from the westward, with heavy squalls of hail, and a heavy sea; middle part the same; ends with heavy squalls.

August 19th. Lat. 39° 23′ S., Long. 100° 07′ E.; bar. 29.40; air 50°, water 50°; winds W. S. W. throughout; blowing fresh from W. S. W., with heavy hail squalls; middle part heavy squalls; ends with a heavy sea.

August 20th. Lat. 39° 42′ S., Long. 105° 19′ E.; bar. 29.40; air 49°, water 50°; winds (for the

three parts) S. W., S. W., W. S. W., to W.; heavy gales, with heavy hail squalls; middle and latter parts the same.

August 21st. Lat. 40° 25′ S., Long. 109° 29′ E.; bar. 29.45; air 51°, water 50°; wind W. N. W. throughout; comes in more moderate; midnight fine breezes and smooth sea; ends strong breeze and passing clouds.

August 22d. Lat. 40° 29′ S., Long. 114° 35′ E.; bar. 29.64; air 56°, water 50°; winds (for the three parts) W. N. W., W. and W; begins with strong breezes; middle squally and rainy; ends clear with strong gales and a smooth sea.

August 23d. Lat. 40° 22′ S., Long. 119° 32′ E.; bar. 29.76; air 50°, water 50½°; (winds for the three parts), W., to W. S. W., W. S. W., S. W.,; strong gales with hail squalls; middle part more moderate; ends moderate with clear weather.

August 24th. Lat. 40° 21′ S., Long. 122° 41′ E.; bar. 29.70; air 53°, water 50°; wind (for the three parts,) S. W., N. W., N. W. Moderate wind with a smooth sea; at 4 P. M. calm; at 9 light baffling winds; at 4 A. M. moderate winds and clear; ends the same.

August 25th. Lat. 40° 23′ S., Long. 128° 09′ E.; bar. —; air 54°, water 50°; wind (for the three parts,) N. W., N., N.; strong breezes with passing clouds.

August 26th. Sun obscured; bar. 29.58; air 54°, water 50°; (winds for the three parts,) N., N.N.E., N. N. E; begins moderate: at 4 P. M. blowing strong; at midnight blowing in heavy squalls; ends heavy gale with thick rainy weather.

August 27th. Lat. 41° 01′ S., Long. 136° 14′ E.; air 52°, water 50°; wind (for the three parts) N. W., W., N. W.; comes in heavy gales, thick weather and heavy sea; middle part more moderate; at 10 A. M. the wind hauling to the Westward in heavy squalls; ends blowing fresh with passing clouds.

August 28th. Lat. 39° 32′ S., Long. 140° 7′; air 60°, water 56°, winds (for the three parts,) N. W., W. comes in with strong gales and heavy rains. At 4 P. M., blowing heavy in squalls. Ends with fine breezes.

August 29th. Sun obscured; winds (for the three parts,) W., W., N. W., and baffling. First part strong breezes and clear. At 2 A. M. made Cape Otoway light bearing N. E. by compass. Ends with baffling winds."

As attaching further interest to this route and these westerly winds of the Southern hemisphere, and also as throwing new light upon the subject before us, I quote from a recent official letter to the Secretary of the Navy:

NATIONAL OBSERVATORY,
Washington, May 10, 1853.

"SIR—The clipper ship "Sovereign of the Seas," McKay, has made such an extraordinary run, that I beg to make it the subject matter of an official report. It is due to builders, owners, and masters, as well as to navigation, that such an achievement should be made known.

"This ship is one of the glorious fleet of a 'thousand sail' that is voluntarily engaged in making observations for the wind and current charts. She it is, it will be recollected, who, taking them for her guide, made the extraordinary run of one hundred and three days from New York to San Francisco, both crossing the Equator in the Pacific, and arriving in port on the day predicted.

"Returning from the Sandwich Islands to New York in the remarkably short run of eighty-two days, she passed through a part of the "Great South Sea," which has been seldom traversed by traders—at least I have the records of none such.

"Little or nothing, except what conjectures suggested, was known as to the winds in this part of the ocean. The results of my investigations elsewhere, with regard to winds and the circulation of the atmosphere, had enabled me to announce as a theoretical deduction, that the winds in the 'variables' of the South Pacific would probably be found to prevail from the westward with a tradewind like regularity.

"Between the parallels of 45 and 55 degrees south, and from the meridian of the Cape of Good Hope eastward, around to that of Cape Horn, there is no land or other disturbing agent to intercept the wind in its regular circuits; here the winds, it was conjectured, would be found blowing from the west with greater force than from the east in the tradewind regions; and, giving rise to that long rolling swell peculiar to those hyperborean regions of the Pacific, they would enable ships steering east to make the most remarkable runs that have ever been accomplished under canvass.

"The "Sovereign of the Seas" has afforded the most beautiful illustration as to the correctness of these theoretical deductions.

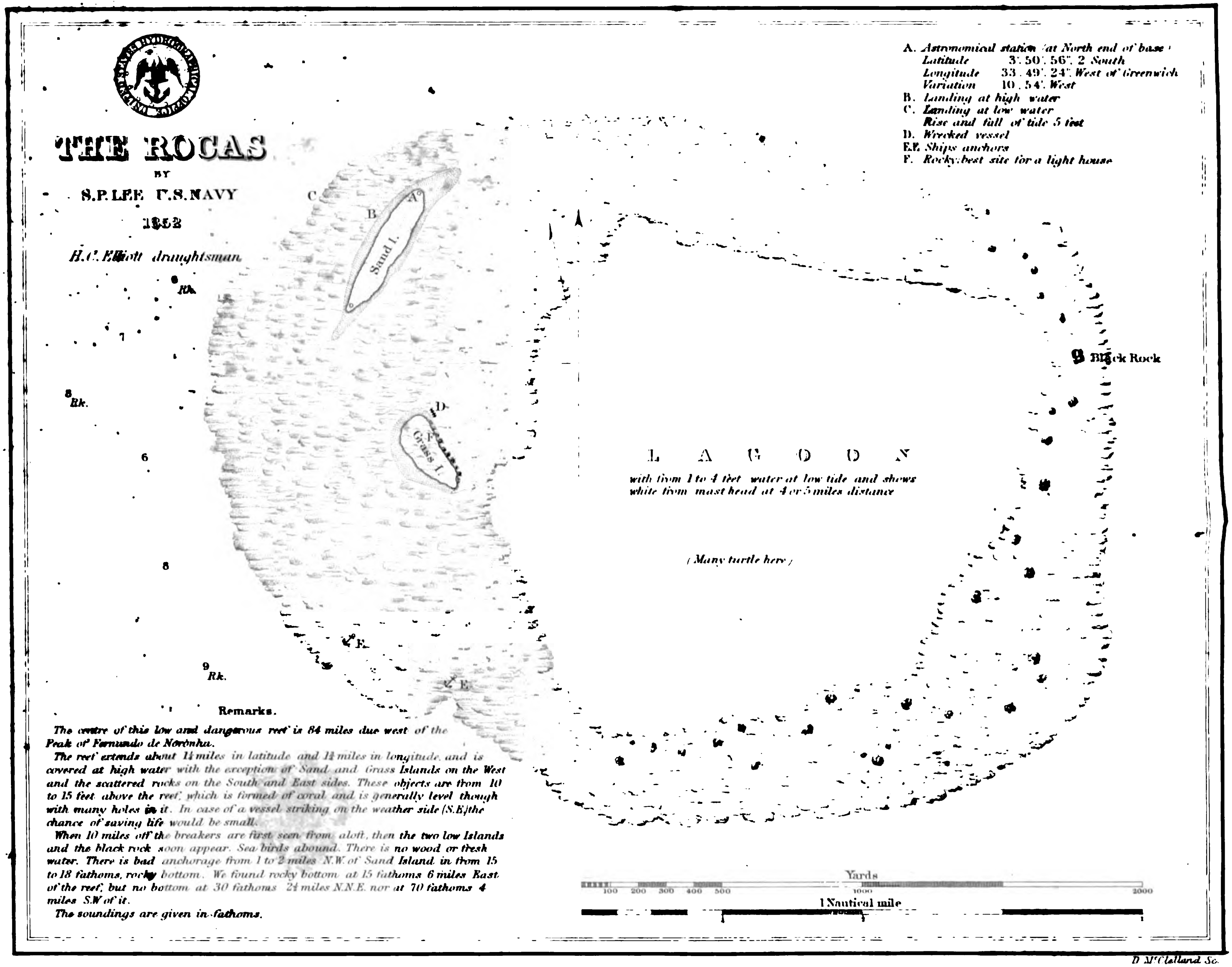
"Leaving Oahu for New York, via Cape Horn, 13th February last, she stood to the southward through the belts, both of the northeast and the southeast trades, making a course good on the average through them, a little to the west of south. She finally got clear of them, March 6th, after crossing the parallel of 45 degrees south, upon the meridian of 164 degrees west.

"The 8th and 9th she was in the horse latitude weather of the Southern hemisphere. So far, her run had been good, but there was nothing remarkable in it.

"Having crossed the parallel of 48 degrees south, she found herself on the 10th, fairly within the tradelike west winds of the Southern ocean; and here commenced a succession of the most extraordinary days' runs that have ever been linked together across the ocean.

"From March 9th to March 31st, from the parallel of 48 degrees south in the Pacific, to 35 degrees south in the Atlantic, during an interval of twenty-two days, that ship made 29 degrees of latitude, and 126 of longitude. Her shortest day's run during the interval, determined by calculation, from the position given in the log, being 150 knots. The wind, all this time, is not recorded but once with easting in it; it was steady and fresh from the westward.

"In these twenty-two days, that ship made five thousand three hundred and ninety-one nautical miles. But that you may the more conveniently contrast her performance with that of railroad cars and river steamers, I will quote her in statute miles.



Remarks.

The centre of this low and dangerous reef is 84 miles due west of the Peak of Fernando de Noronha.

The reef extends about 1½ miles in latitude and 1½ miles in longitude, and is covered at high water with the exception of Sand and Grass Islands on the West and the scattered rocks on the South and East sides. These objects are from 10 to 15 feet above the reef; which is formed of coral, and is generally level though with many holes in it. In case of a vessel striking on the weather side (S.E.) the chance of saving life would be small.

When 10 miles off the breakers are first seen from aloft, then the two low Islands and the black rock soon appear. Sea birds abound. There is no wood or fresh water. There is bad anchorage from 1 to 2 miles N.W. of Sand Island in from 15 to 18 fathoms, rocky bottom. We found rocky bottom at 15 fathoms 6 miles East of the reef; but no bottom at 30 fathoms 2½ miles N.N.E. nor at 70 fathoms 4 miles S.W. of it.

The soundings are given in fathoms.

A.

Head lands, between C. Blanco and Port San Quentin.

Cape Blanco, (per Compass) N. by E.

Outline of Acapulco Pt. or Island, N. W. by W. ½ W. distant 18 miles.

In making Acapulco from the Sd, follow along the beach 'til it ceases, and the Island will be ahead, near. Steer in, favoring the right hand shore until inside, then for the Town, taking particular pains not to get to the right of the Fort. N. B. On the top of a hill, back of Acapulco, is a Telegraph Station on which a light is generally shown at night.

Cape Corrientes, N. E ¼ E. 30. Lat. 20 07' 8"

Outline of Cape Corrientes, N by E. 20 miles.

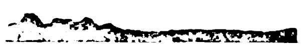
Cape Corrientes, bearing S.E. ¼ E.

S. E. Island, N. W by W.

Middle Island of Tres Marias. N. W ¼ N.

Cape St. Lucas, W. S W ¼ W 12 miles.

Cape St. Lucas, N. E. by E. ¼ E. 10 miles.



Cape Colnett from the Northward.

Cape Colnett from the Sd

North Pt. of St. Quentin Bay, with the Island of St. Martin.

A.

Head lands, between C. Blanco and Port San Quentin.

Cape Blanco, (per Compass) N. by E.

Outline of Acapulco Pt. or Island, N. W. by W. ¼ W. distant 10 miles.

In making Acapulco from the Sd., follow along the beach 'til it ceases, and the Island will be ahead near. Steer in, favoring the right hand shore until inside, then for the Town, taking particular pains not to get to the right of the Fort. N. B. On the top of a hill, back of Acapulco, is a Telegraph Station on which a light is generally shown at night.

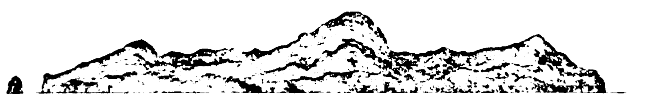
Cape Corrientes, N. E. ¼ E. 30. Lat. 20° 07' 8"

Outline of Cape Corrientes, N. by E. 20 miles.

Cape Corrientes, bearing S. E. ¼ E.

S. E. Island, N. W. by W.

Middle Island of Tres Marias, N. W. ¼ N.



Cape St. Lucas, W. S. W. ¼ W. 12 miles.

Cape St. Lucas, N. E. by E. ¼ E. 10 miles.

Cape Colnett from the Northward.

Cape Colnett from the Sd.

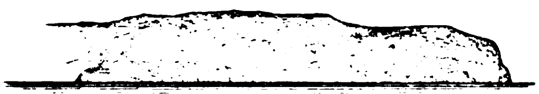
North Pt. of St. Quentin Bay, with the Island of St. Martin.

B.

Head lands, between Port San Quentin and Sta Catalina.

Island of San Martin, seen from either side appears as above, and can be seen going South, when abreast of Cape Colnett, if clear. The lumps, forming the north point of San Quentin Bay, also begin to show when abreast of, and just before reaching Cape Colnett. From the lumps, low land runs off Southward a mile or two, terminating in low rocks. At this place is a good harbor 4 fathoms water and plenty of room.

Todos Santos, South Pt. N.¼W (per Compass) 10 miles. The Bay of Todos Santos opens to the Nd & Wd and in the middle of its mouth, is an Island and some rocks. A little south of the Coronados, is a rock, flat on top and low, a mile and a quarter from the land.



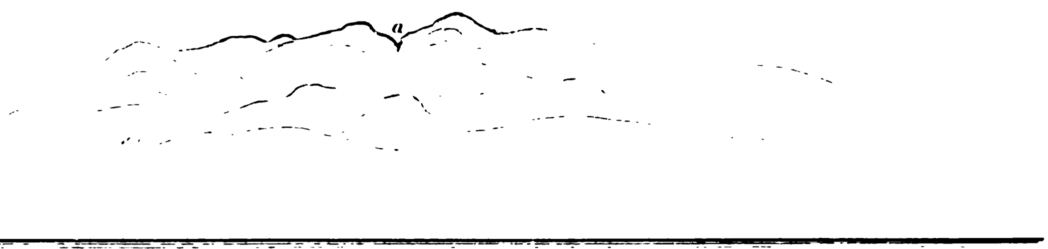
Point Loma, North side of Entrance of St. Diego, N.E.¼E. distant 10 miles.

Santa Barbara, W.N.W. 12 miles. When the outer point to Westd is W.S.W. steer N.W by W. and you will fetch the anchorage. High water full and change 9¼ rise and fall 6 feet

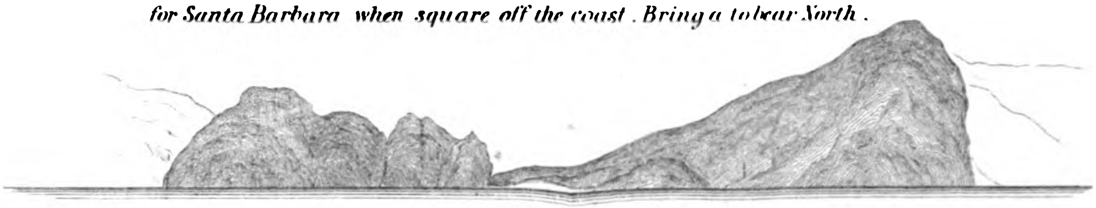
Point Buena Ventura, bearing E. by S¼S. distant 15 miles.

Santa Barbara Anchorage. Church and Flag Staff in range N.W. Outer point S.W.

N.W. end of Catalina, S.S.W. distant 5 miles.



a, Is a notch above Santa Barbara and it is the only mark by which to steer for Santa Barbara when square off the coast. Bring a to bear North.



Entrance to Catalina Harbor.

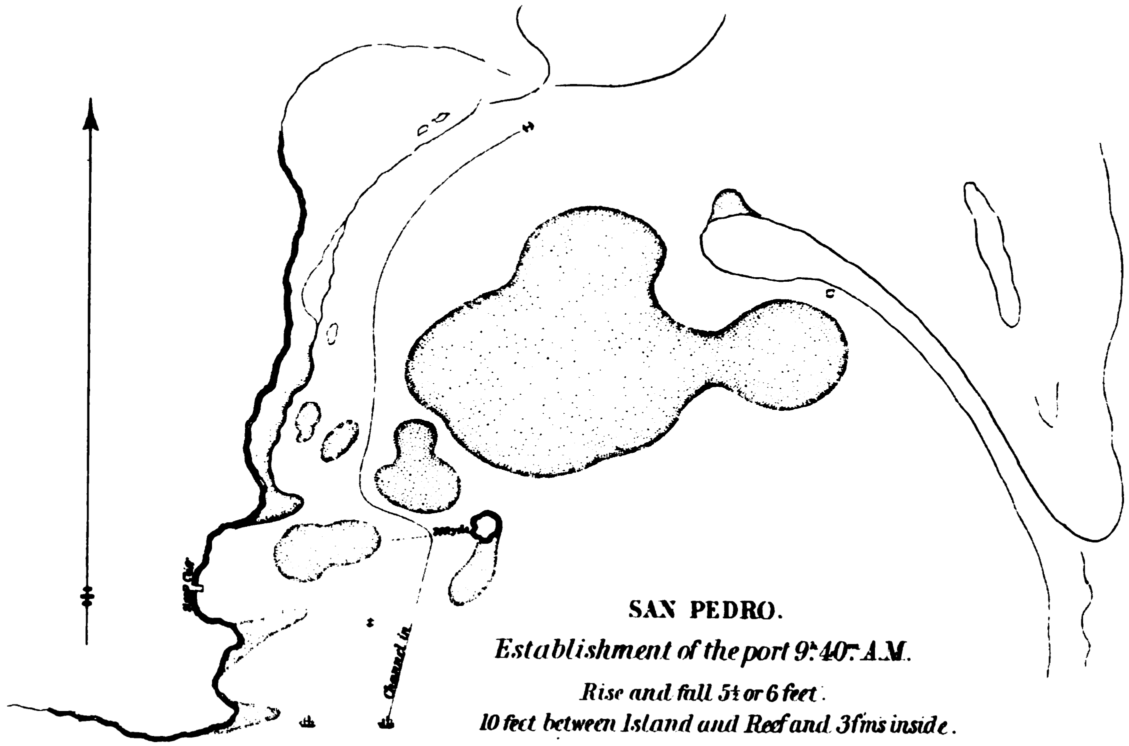
C.

Head lands, between S^ta Catalina and Point Arguello.

Point Famine, E.N.E. distant 12 miles.

Anacapita, S.S.E.½E. *Barren Islands, S.S.E.* *Anacopua, S. by E.*

Dona Point, near Buenaventura mission, bearing East dist. 5 miles.



Pt. Conception, E.½ S. dist. 7 miles.

Pt. Conception, W½S. dist. 7 miles.

Pt. Arguello, N.W.½W. distant 6 miles.

Pt. Arguello, S. by E.½E.

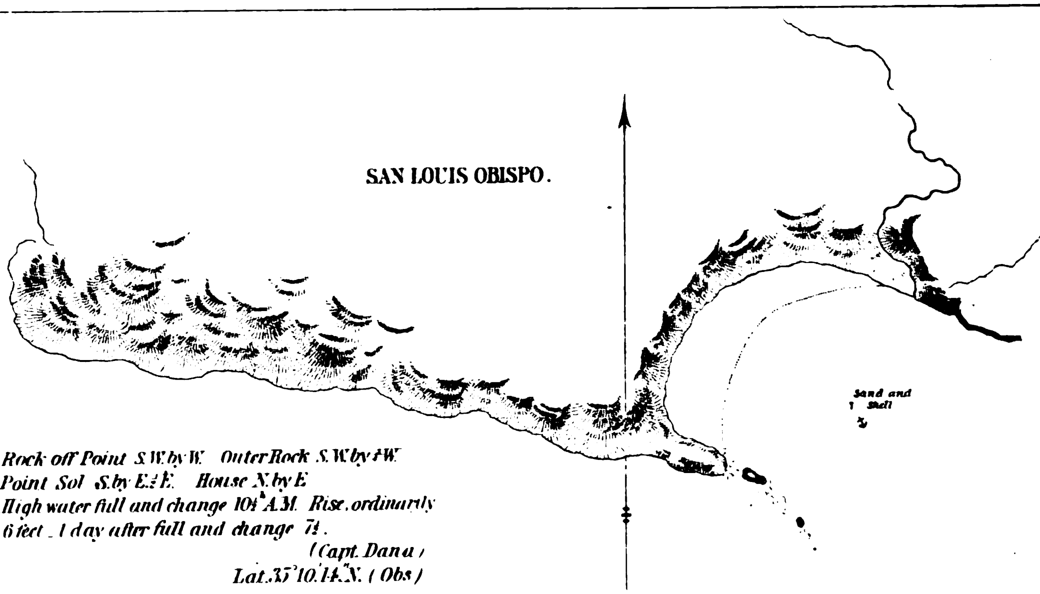
D.

Head lands, between Point Arguello and Esteros Bay.

Rocks off San Louis Obispo, appearing round the point, S.E ¼ E. (per Compass)

Another view of same.

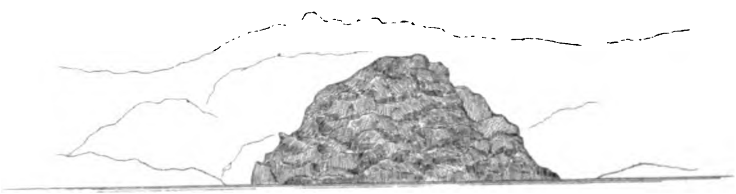
Pt. Sol, extreme point bearing S.E. by S. dist. 12 miles.
The land on south side of San Louis is low and sandy; and, towards Pt. Sol, rises to high land: the part near the Sea being sand hills. Sand beach and sand hills in the bight between these points.
"Edith's" wreck 5 miles from Pt. Sol.



Rock off Point S.W. by W. Outer Rock S.W. by ¼ W.
Point Sol S. by E. ¼ E. House N. by E.
High water full and change 10¼ h A.M. Rise, ordinarily 6 feet. 1 day after full and change 7¼.
(Capt. Dana)
Lat. 35° 10′ 14″ N. (Obs.)

Esteros Point, North side of the Bay, E¼N. distant 4 miles. Lat. 35° 30′ N.

Point on South of Esteros Bay, S.E. ¼ S.



Esteros Rock N.E. distant 5 miles
Nd of Estero the land is high (back) and a double peak; and the upper edge of the Coast hills are wooded.
To enter the Estero, keep close to rock on North side, steering for Pt of low land on the right; when near it, for point on left, then hard a port and keep channel close to right hand shore.

Esteros Point to North bearing N.W.

E.

Headlands, between Esteros Bay and Monterey.

Pt. St. Simeon East 2 miles. Land sloping down gently, with lofty ragged mountains farther back. Marks for St. Simeon: Timber on hill top just back of anchorage. Anchor six miles to leeward (Sd. and Ed.) of rocks. (Capt. Willson) Lat. 35°42'N. per Chart by Capt. Hansen, 35°37'. Anchorage 35°35'. Bay shaped like a horse shoe, half way between rocks and houses.

Pt. Simeon, N. W. by W. dist. 4 miles. Safe anchorage and good watering place. 10 miles to the Sd. is a clump or patch of woods, with an old house near it; below this, two or three miles, is another larger tract of wooded land, with a strip of open land next the sea. The land lies well for cultivation, grazing &c. but there is no apparent shelter for anchoring.

Point Lobos, N.W. by N. distant 15 miles.
Land to the Sd. high, broken and steep to the water.
Lat. 36°24'N.

Point Cyprus, N ¼ W. distant 3¼ miles.
Lat. 36°33'.

Point St. Pedro, per compass, E. by S ½ S. distant 7 miles.
Lat. 37°33'N.

Point Pinos, N.E. by E. distant 6 miles.
Lat. 36°38'

Point Cyprus S.E.E½E.

Point Lobos, S.S.E. distant 12 miles
Land between Pt. Lobos and Pt. Cyprus high and broken with beach.

Cape Blanco, N.E. distant 3 miles. To the Nd. is an indentation; to the Sd. high land, sand beach and rocky shore at intervals. To the Sd. a lower point (Point San Pedro) with three or four rocks off the point, sharp and sugarloaf like. See a.

F.

Head lands, between Columbia River and San Francisco.

Point George and Rocks off same.
Pt. George bearing (per Compass) S.E.by E.½E.

Point Ellice opening above Cape Disappointment.
a, Point Adams. b, Tongue Pt. c, Cockscomb Hill. e, Point Ellice. Pt. Adams and Cockscomb just open, is the range for crossing bar. North Channel.

Cape Disappointment,
bearing (per Compass) East 25 miles. a, Cape.

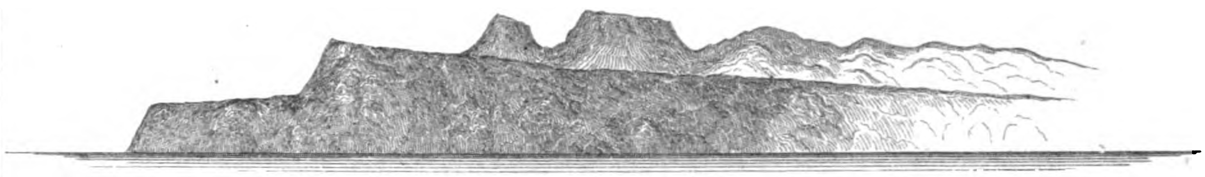
Cape Disappointment,
bearing (per Compass) East 15 miles. a, Cape.

Point Trinidad, 9 miles S.E.½E.

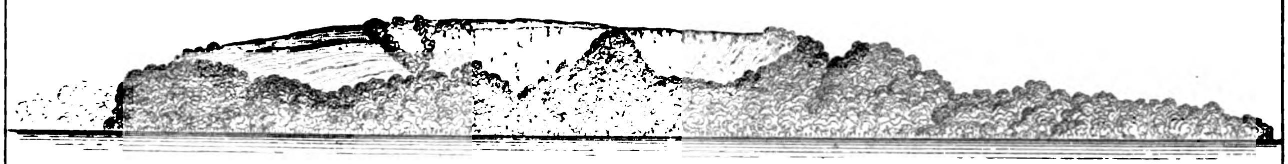
Rocks at Point Trinidad, from Sd & Wd

G.

Views of the S.W. Coast of Africa.



South Point of Elephant Bay, bearing S. by E. 17 miles. Taken early in the morning when the outline is just visible, and the mountains back of the bay nearly concealed by the fog. Entering the bay you must keep well to the South. When you bear up, take two or three reefs in the topsails, for when you round the point the squalls come over the land with the violence of a gale. Yet apart from this the anchorage is as smooth as a calm, being under the lee of very high hills. The Bay swarms with fish of every description and affords a rare enjoyment both with the sein and line. Anchor a cable and a half from the shore in six fathoms, sandy bottom. The place is not inhabited and the aspect of the country, that of the wildest desolation.

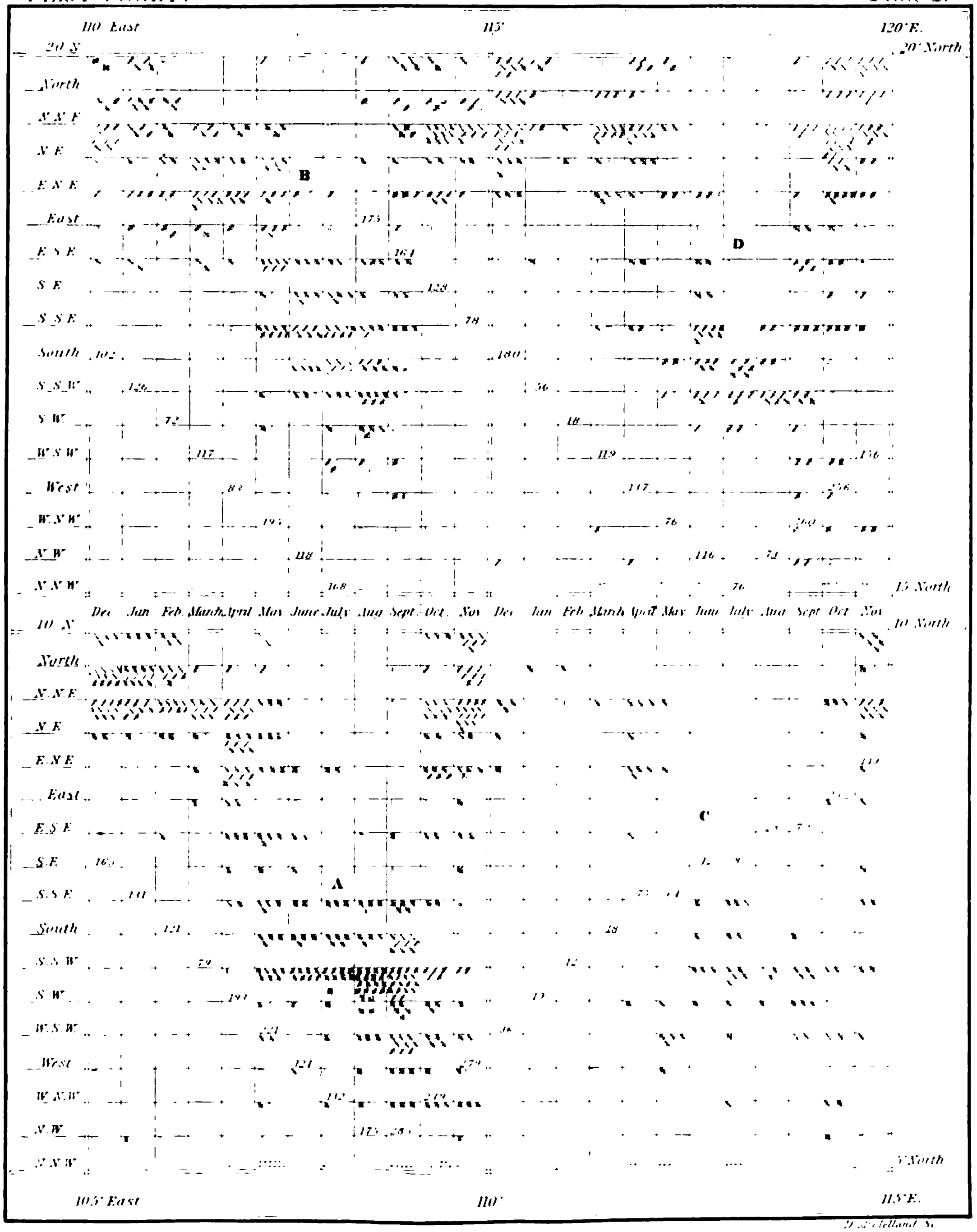


High Red Cliffs to the Northward of Loango, which are distinguished by the mound of trees in the middle

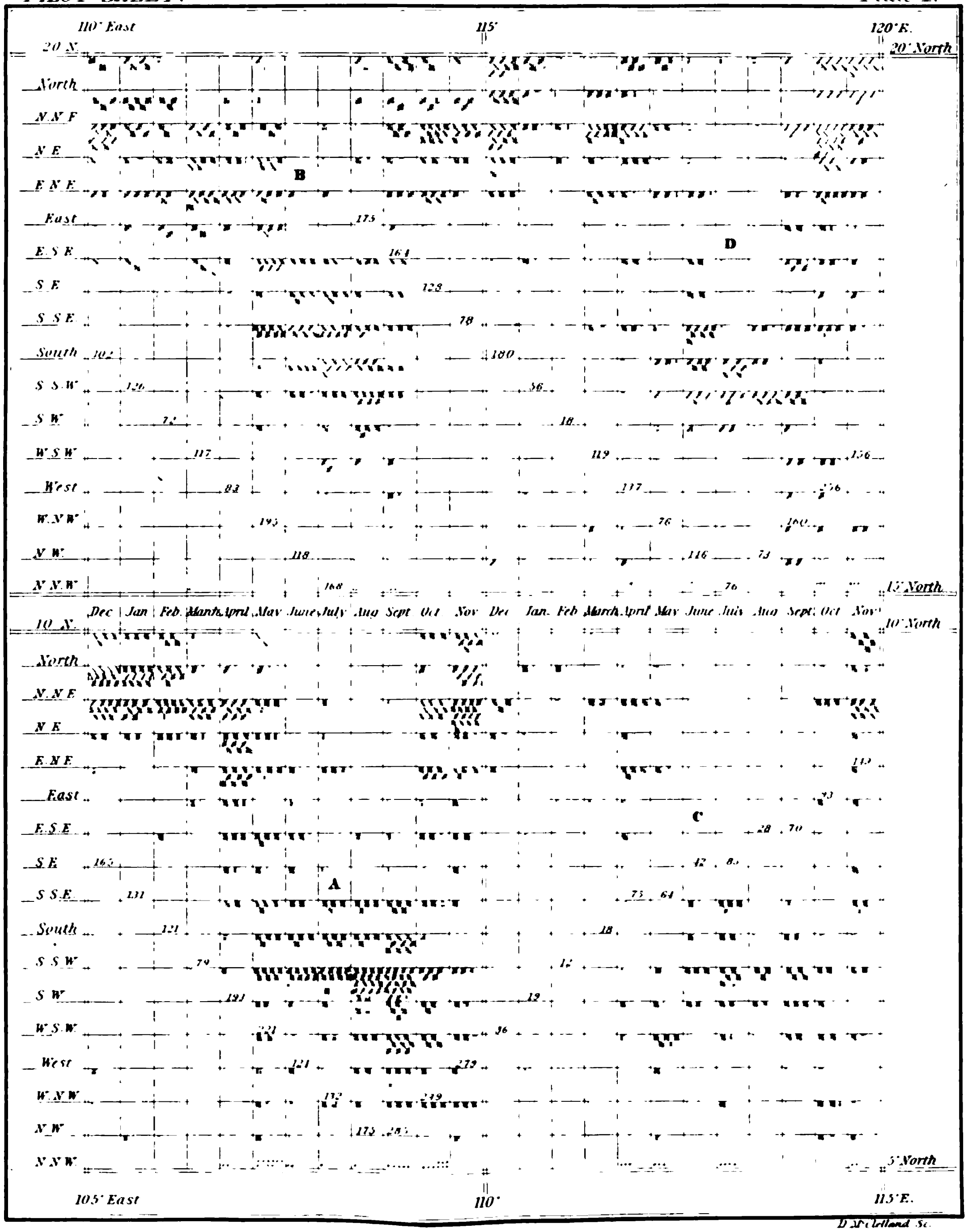
The Land East from the Anchorage with a clump of trees called "Looboo Wood." When bearing S.E. by E. (comp.^s) steer for it.

From the Point which forms the Bay, to the South Point.
At this point the reef runs in a N.N.W. direction (comp.^d) 1½ mile.

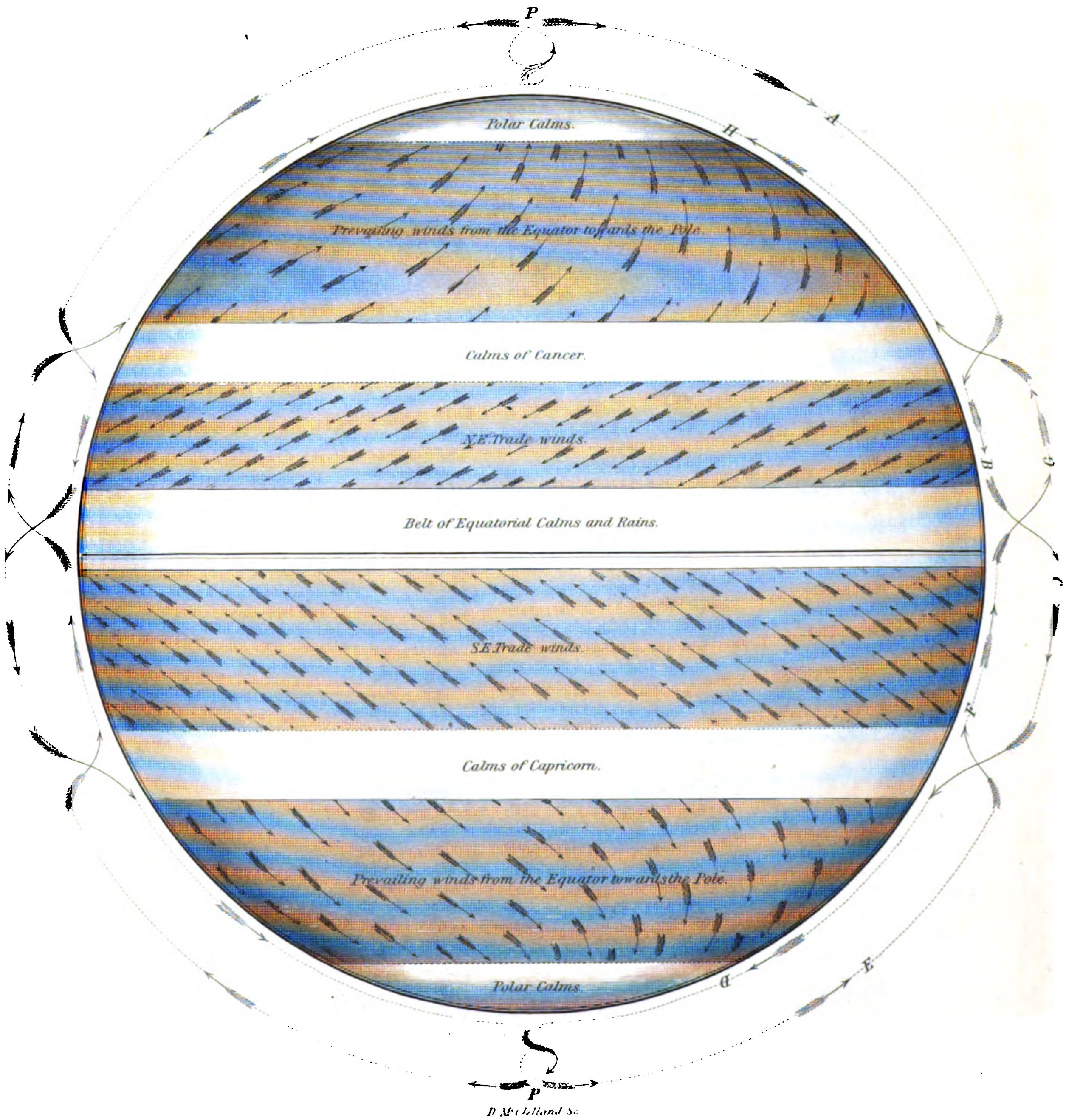
PILOT SHEET. Plate 1.

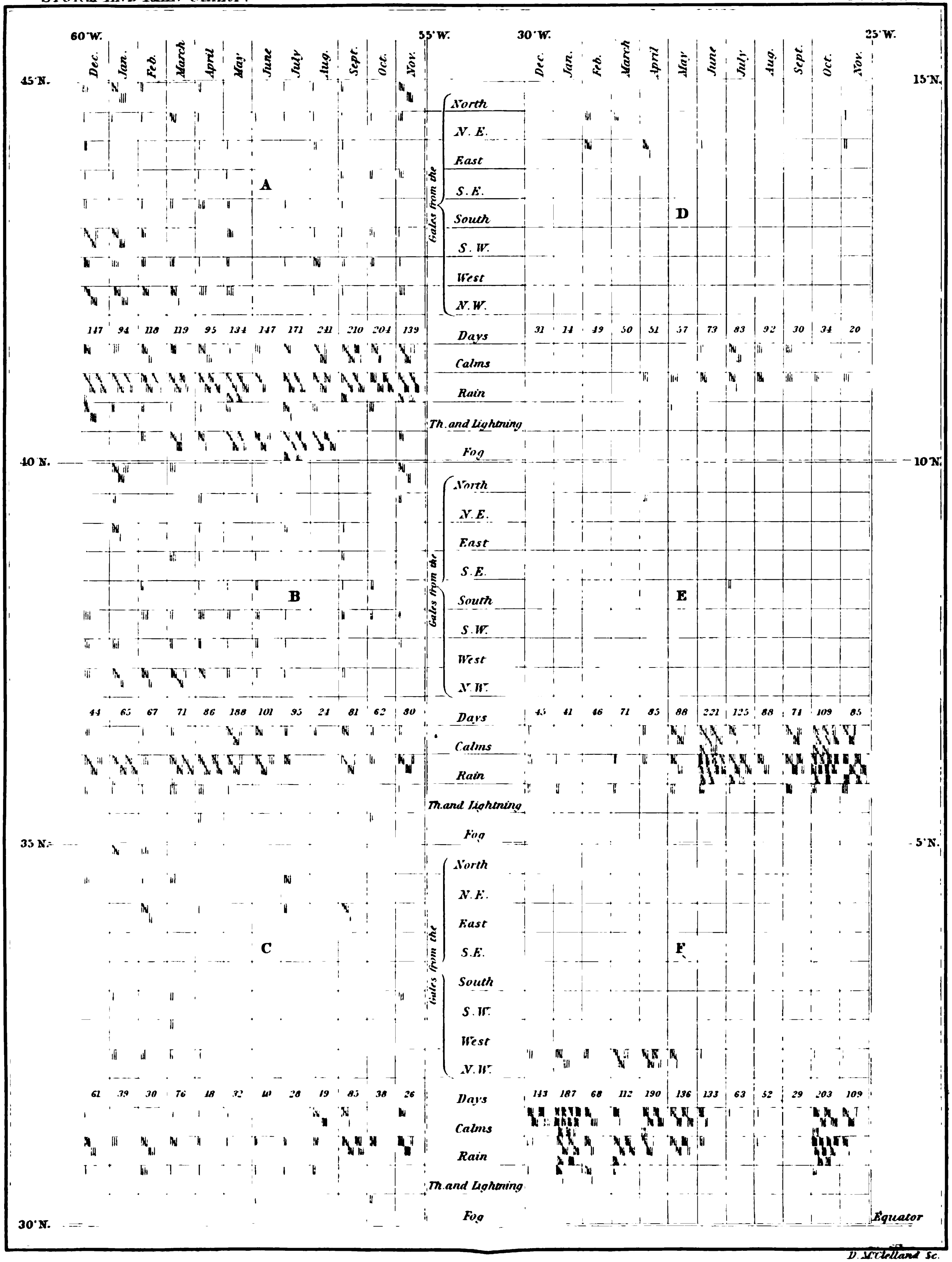


PILOT SHEET. Plate 1.



D. M'Clelland Sc.


P
A
H
Polar Calms.
Prevailing winds from the Equator towards the Pole.
Calms of Cancer.
N.E. Trade winds.
B
C
Belt of Equatorial Calms and Rains.
S.E. Trade winds.
F
Calms of Capricorn.
Prevailing winds from the Equator towards the Pole.
D
E
Polar Calms.
P
D. McLelland Sc.



D. M'Clelland Sc.

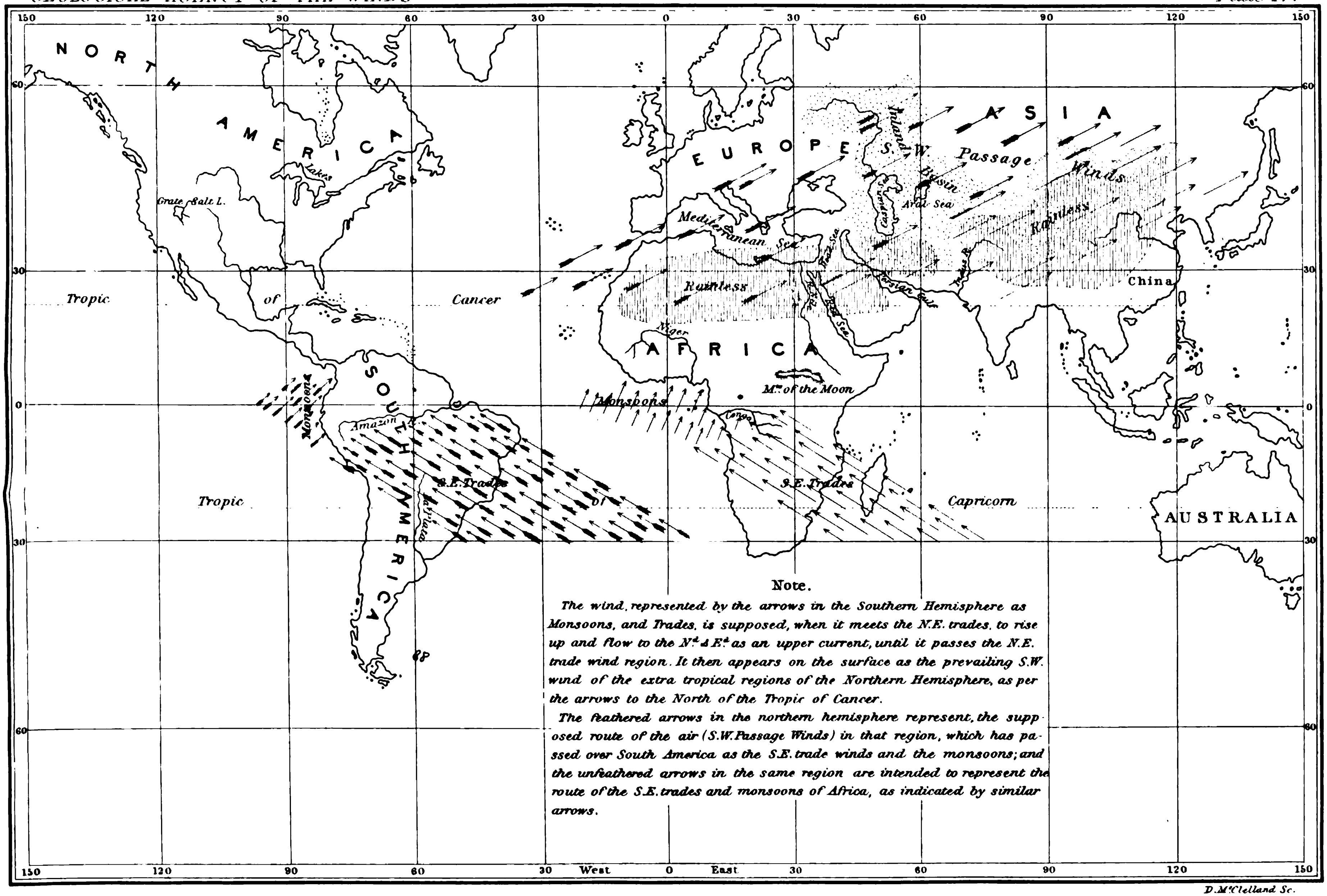

NORTH AMERICA
SOUTH AMERICA
EUROPE
ASIA
AFRICA
AUSTRALIA
Grate Salt L.
Lakes
Tropic of Cancer
Tropic of Capricorn
Mediterranean Sea
Red Sea
Persian Gulf
Caspian Sea
Aral Sea
Inland Basin
S.W. Passage Winds
Rainless
China
Niger
Congo
Mts. of the Moon
Monsoons
S.E. Trades
Amazon
La Plata
West
East
Note.
The wind, represented by the arrows in the Southern Hemisphere as Monsoons, and Trades, is supposed, when it meets the N.E. trades, to rise up and flow to the Nd. & Ed. as an upper current, until it passes the N.E. trade wind region. It then appears on the surface as the prevailing S.W. wind of the extra tropical regions of the Northern Hemisphere, as per the arrows to the North of the Tropic of Cancer.
The feathered arrows in the northern hemisphere represent, the supposed route of the air (S.W. Passage Winds) in that region, which has passed over South America as the S.E. trade winds and the monsoons; and the unfeathered arrows in the same region are intended to represent the route of the S.E. trades and monsoons of Africa, as indicated by similar arrows.
D. McClelland Sc.

Plate V.

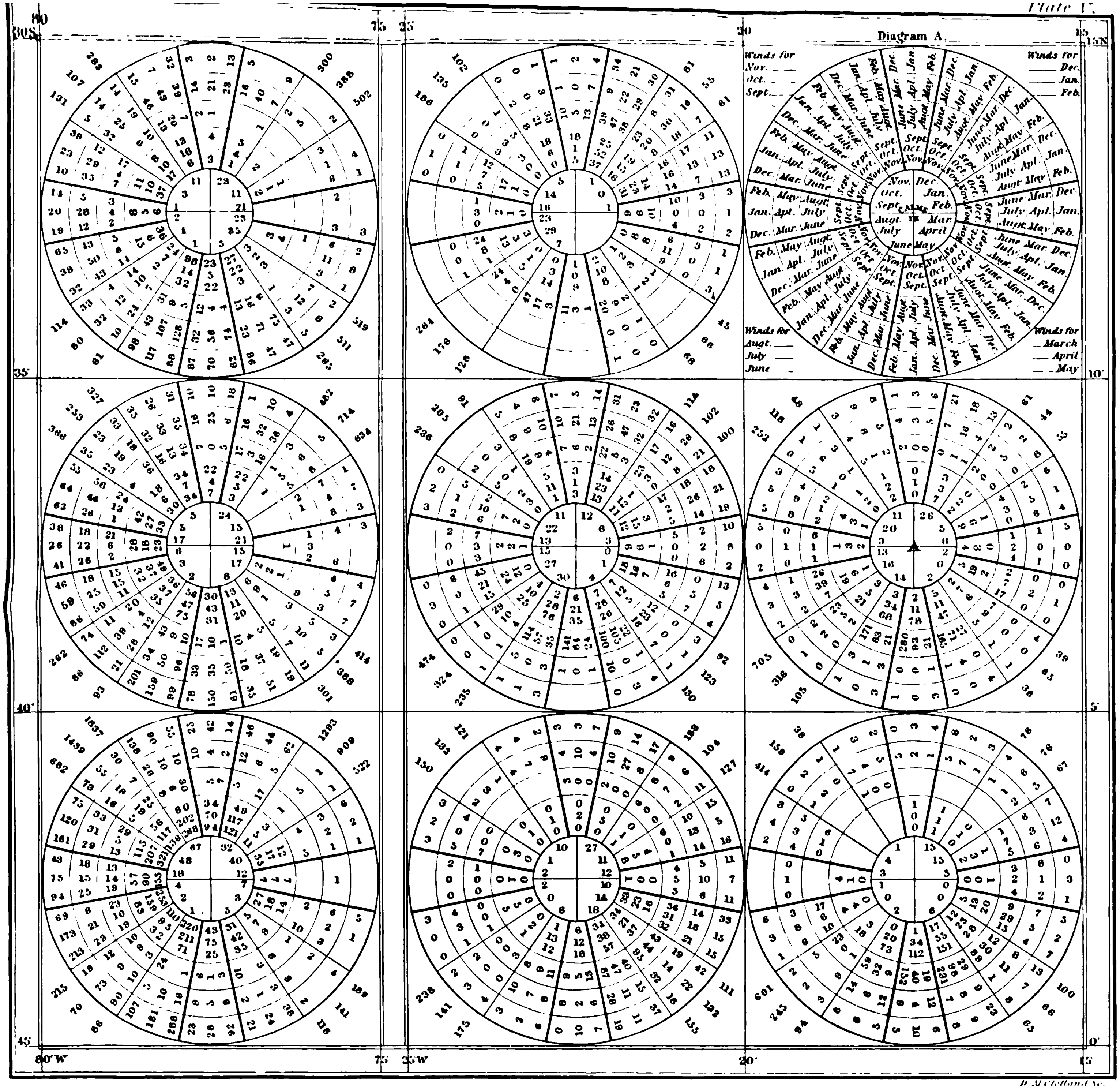
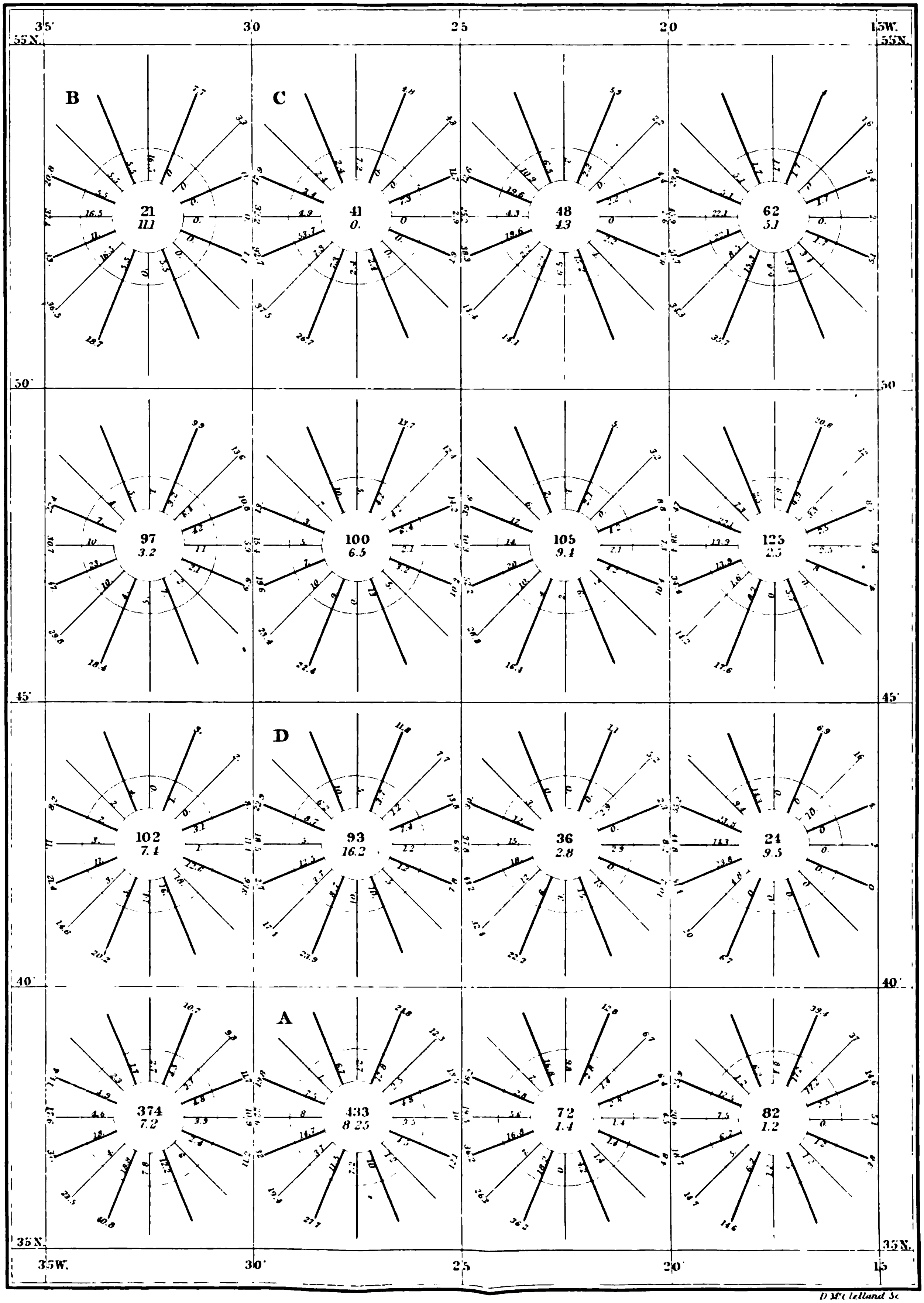
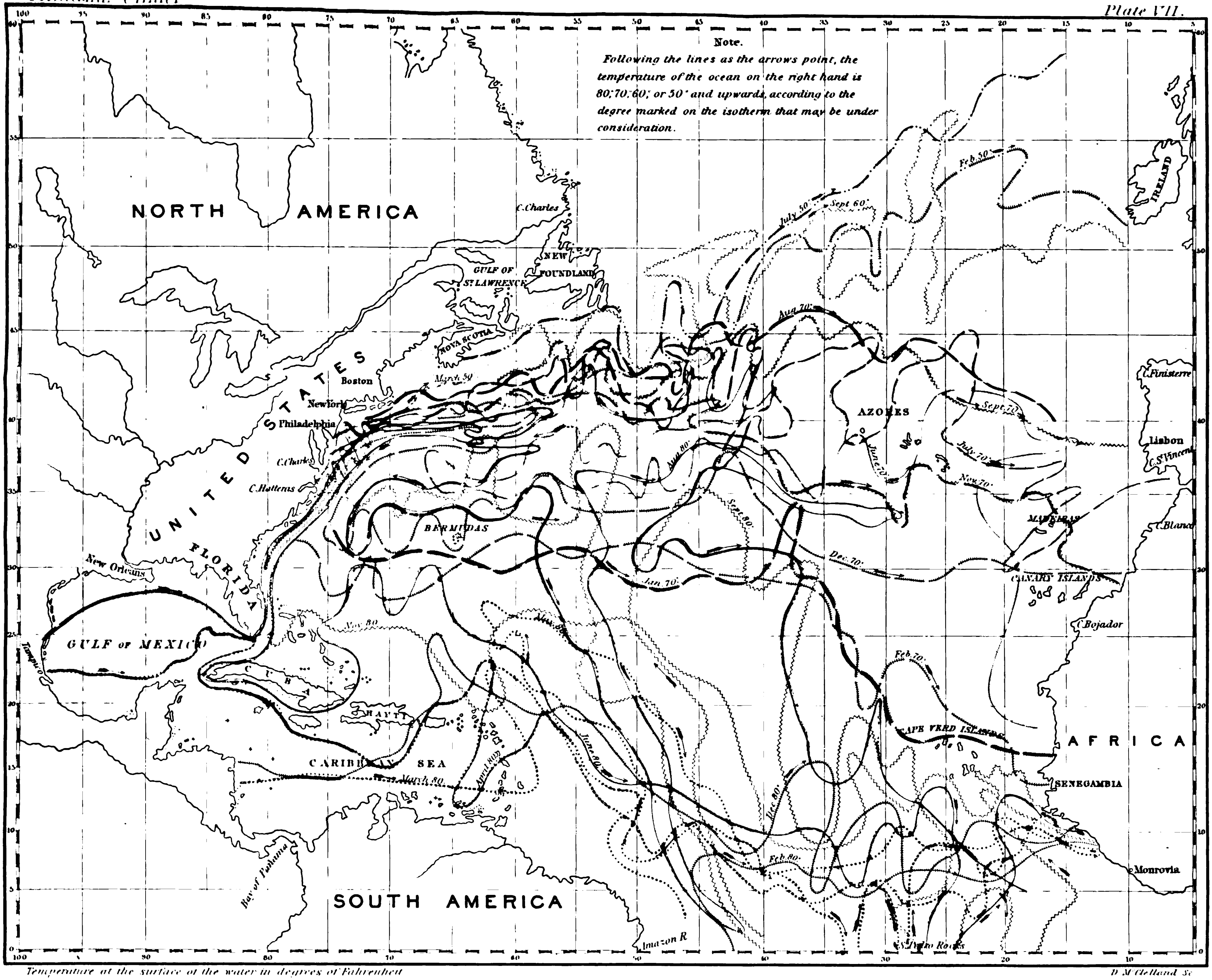
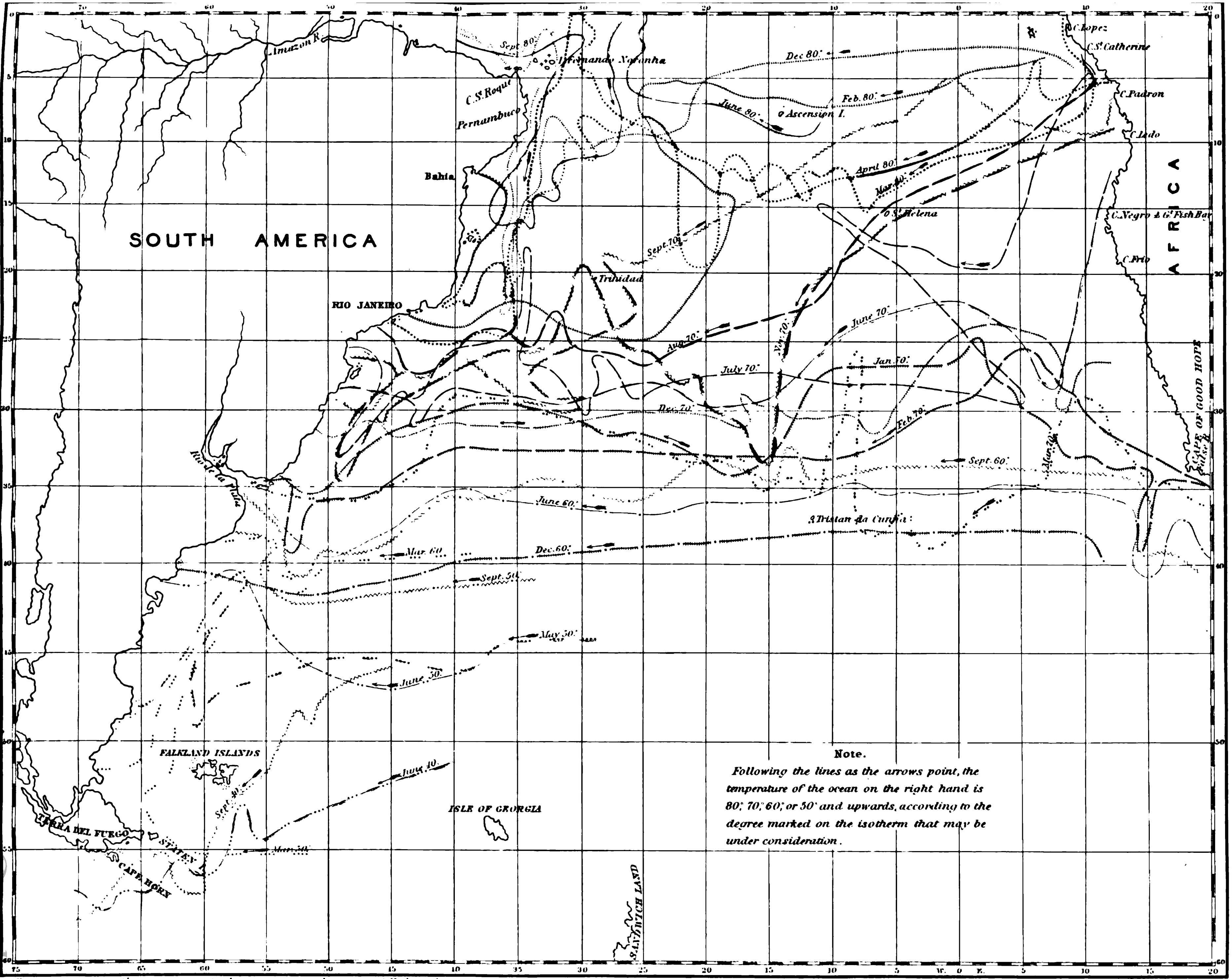


Diagram A.
Winds for Nov. Oct. Sept.
Winds for Dec. Jan. Feb.
Winds for Augt. July June
Winds for March April May
D. M'Clelland Sc.



D. McClelland Sc.


Note.
Following the lines as the arrows point, the temperature of the ocean on the right hand is 80°, 70°, 60°, or 50° and upwards, according to the degree marked on the isotherm that may be under consideration.
NORTH AMERICA
UNITED STATES
FLORIDA
GULF OF MEXICO
SOUTH AMERICA
AFRICA
IRELAND
AZORES
BERMUDAS
CUBA
HAYTI
CARIBBEAN SEA
GULF OF ST LAWRENCE
NEW FOUNDLAND
NOVA SCOTIA
CANARY ISLANDS
CAPE VERD ISLANDS
SENEGAMBIA
MADEIRAS
Boston
New York
Philadelphia
C. Charles
C. Hatteras
New Orleans
Tampico
Bay of Panama
Amazon R.
St Paulo Rocks
Monrovia
C. Bojador
C. Blanco
C. St Vincent
Lisbon
C. Finisterre
Feb. 50°
July 50°
Sept. 60°
Aug. 70°
Sept. 70°
July 70°
Nov. 70°
June 70°
Dec. 70°
Jan. 70°
Feb. 70°
Aug. 80°
Sept. 80°
Nov. 80°
Dec. 80°
Feb. 80°
June 80°
March 80°
April 80°
March 50°
Temperature at the surface of the water in degrees of Fahrenheit
D. M'Clelland Sc.



Temperature at the surface of the water in degrees of Fahrenheit.

D. McClelland Sc.

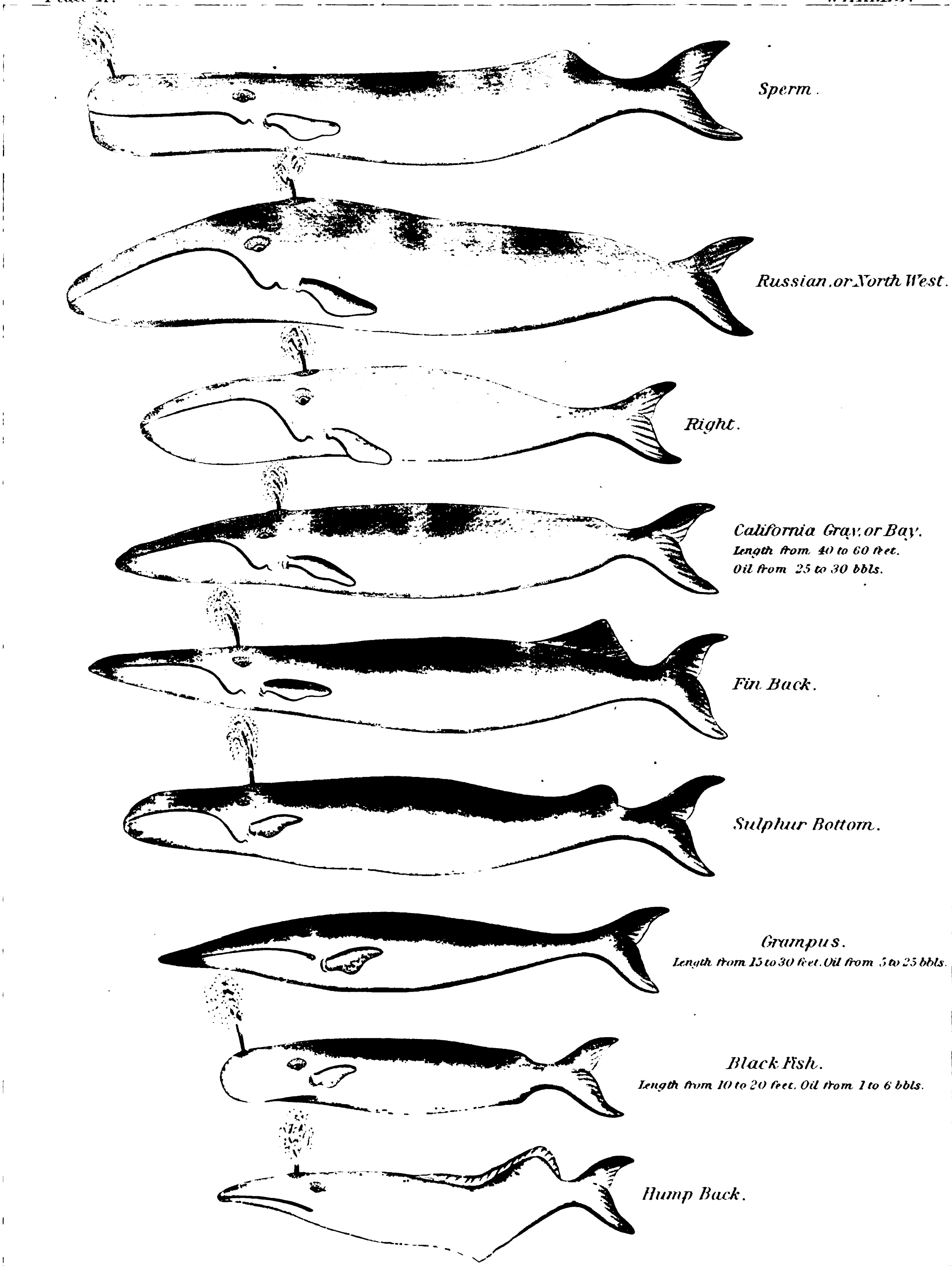
130° — 125° (Lat. North)

Lat. North		Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	
60°	Nº days of search													D
	Nº days on which found whales													S
														R
55°	Nº days of search									2				D
	Nº days on which found whales													S
														R
50°	Nº days of search							7		13				D
	Nº days on which found whales													S
														R
45°	Nº days of search							10	5	17	2			D
	Nº days on which found whales													S
														R
40°	Nº days of search							4	7	11	8	4		D
	Nº days on which found whales													S
														R
35°	Nº days of search										9	9	9	D
	Nº days on which found whales													S
														R
30°	Nº days of search	28	7								4	3	3	D
	Nº days on which found whales													S
														R
25°	Nº days of search	3		2	5		2	1	3				4	D
	Nº days on which found whales													S
														R
20°	Nº days of search	4	5	6	2	5							2	D
	Nº days on which found whales													S
														R
15°	Nº days of search	3	3		4	6	2							D
	Nº days on which found whales													S
														R
10°	Nº days of search	2	7	6	8	4		5	3	6				D
	Nº days on which found whales													S
														R
5°	Nº days of search	5	25	25	23	45	37	4		4	6	7	2	D
	Nº days on which found whales													S
0° Equator														R

130° — 125° W. (Lat. South)

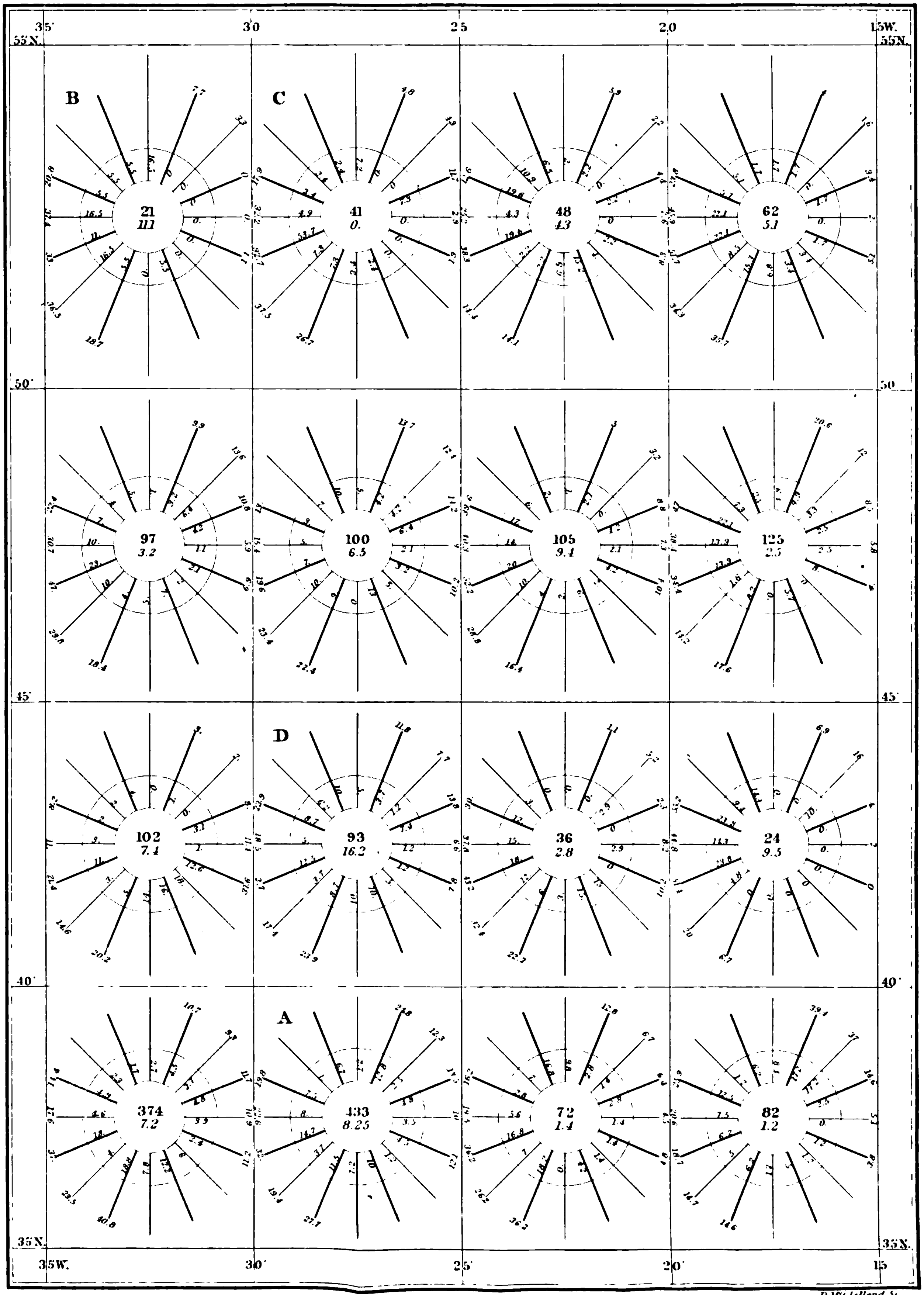
	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Lat. South
D	10	89	110	85	44	74	73	82	29	10	13	8	Equator 0°
S													
R													S. Lat. 5°
D	3		6	4	4		2			5			
S													
R													10°
D	15			8			2	3	1				
S													
R													15°
D	12		2	4		4	3	3	2				
S													
R													20°
D	11	9		8		16		3					
S													
R													25°
D	4	20	14		6	15	4		5				
S													
R													30°
D		16	7			4					2	2	
S													
R													35°
D				3	3		2						
S													
R													40°
D	2	2	9	4			4				3		
S													
R													45°
D	7	9	12	1	1	2	3	2	2				
S													
R													50°
D			4	5							2		
S													
R													55°
D													
S													
R													60°

D. M'Clelland Sc

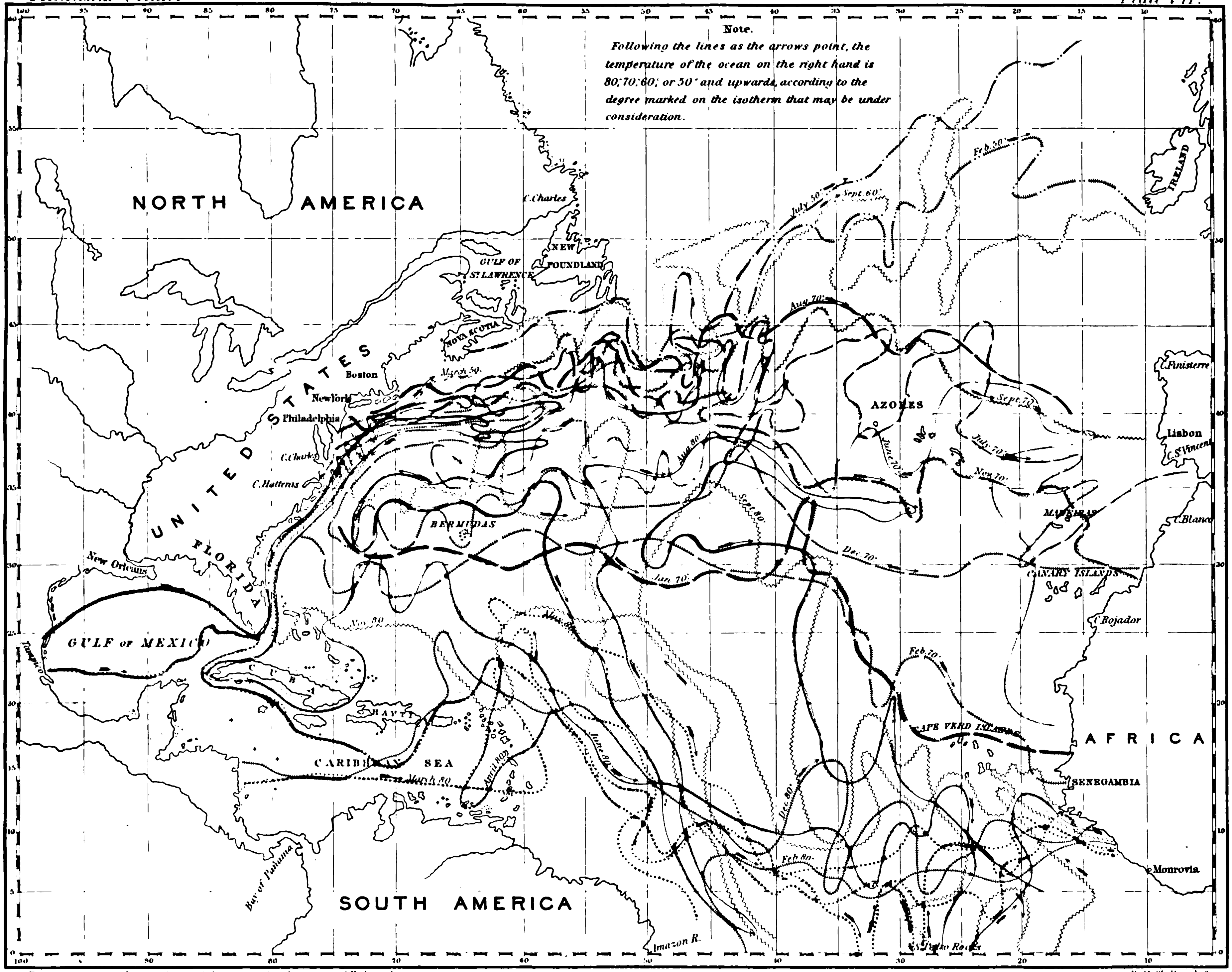


D M^c Lelland Sc

Plate VI.

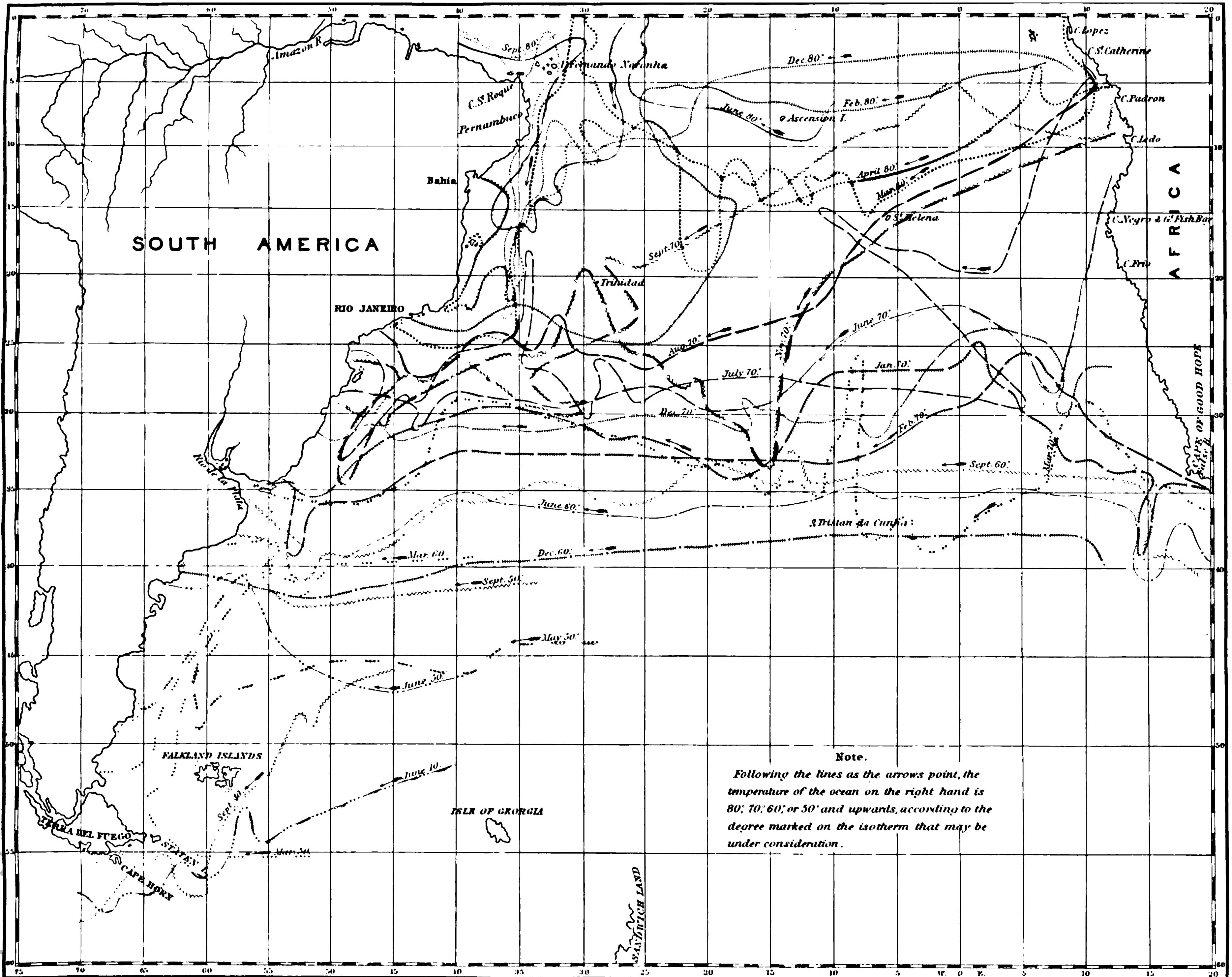


D M'Clelland Sc



Temperature at the surface of the water in degrees of Fahrenheit

D. McClelland Sc.



Temperature at the surface of the water in degrees of Fahrenheit.

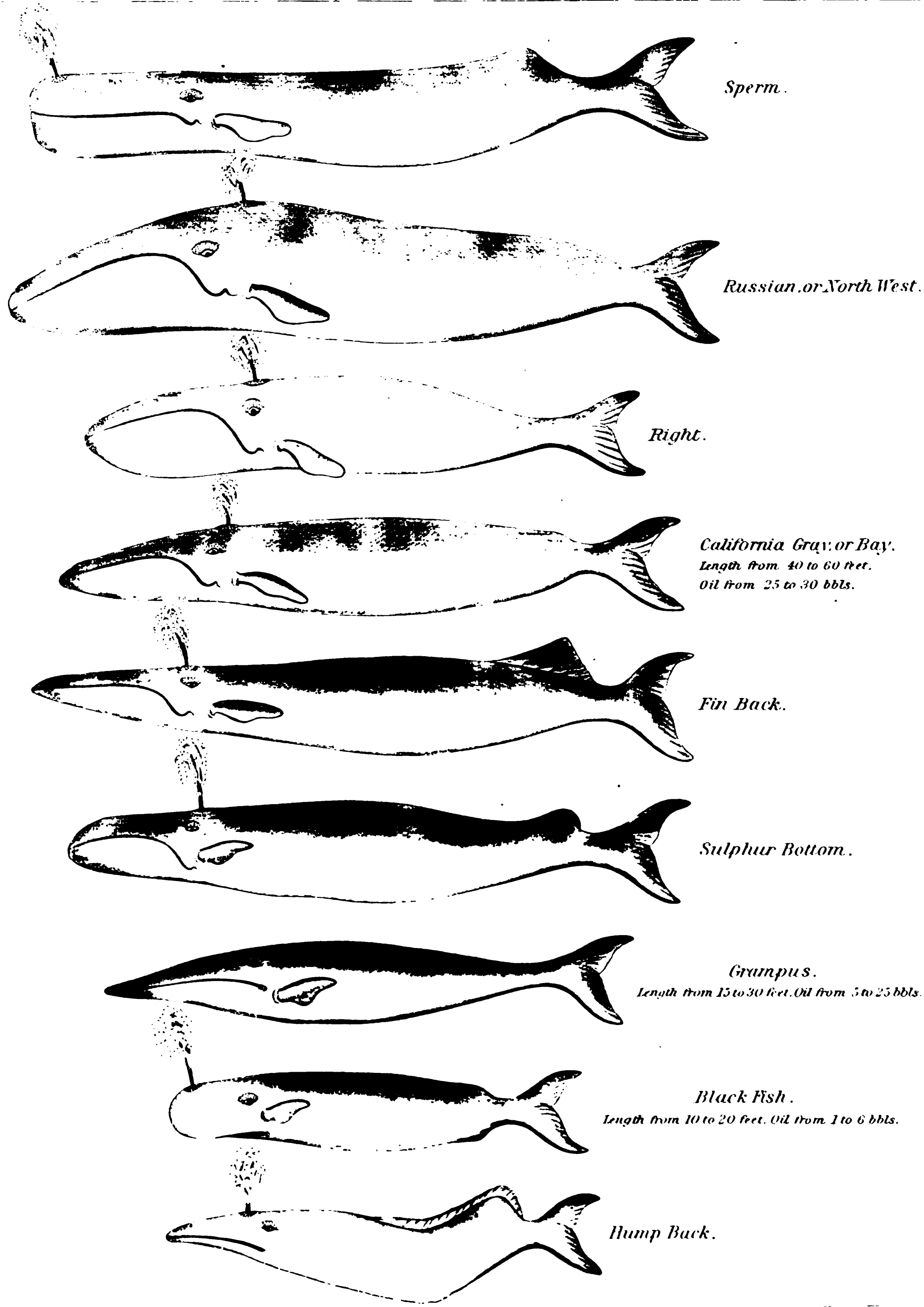
J. McClelland Sc.

WHALE CHART. Plate IX.

130° 125° 130° 125° W.

Lat. North		Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.		Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Lat. South
60°	N° days of search													D	10	89	110	85	44	74	73	82	29	10	13	8	Equator 0°
	N° days on which found whales													S													
														R													S. Lat.
55°	N° days of search									2				D	3		6	4	4		2			5			5°
	N° days on which found whales													S													
														R													
50°	N° days of search							7		13				D	15			8			2	3	1				10°
	N° days on which found whales													S													
														R													
45°	N° days of search							10	5	17	2			D	12		2	4		4	3	3	2				15°
	N° days on which found whales													S													
														R													
40°	N° days of search							4	7	11	8	4		D	11	9		8		16		3					20°
	N° days on which found whales													S													
														R													
35°	N° days of search										9	9	9	D	4	20	14		6	15	4		5				25°
	N° days on which found whales													S													
														R													
30°	N° days of search	28	7								4	3	3	D		16	7			4					2	2	30°
	N° days on which found whales													S													
														R													
25°	N° days of search	3		2	5		2	1	3				4	D				3	3		2						35°
	N° days on which found whales													S													
														R													
20°	N° days of search	4	5	6	2	5							2	D	2	2	9	4			4				3		40°
	N° days on which found whales													S													
														R													
15°	N° days of search	3	3		4	6	2							D	7	9	12	1	1	2	3	2	2				45°
	N° days on which found whales													S													
														R													
10°	N° days of search	2	7	6	8	4		5	3	6				D			4	5							2		50°
	N° days on which found whales													S													
														R													
5°	N° days of search	5	25	25	23	45	37	4		4	6	7	2	D													55°
	N° days on which found whales													S													
0° Equator														R													60°

D. McClelland Sc.



D McLelland Sc

Plate XI.

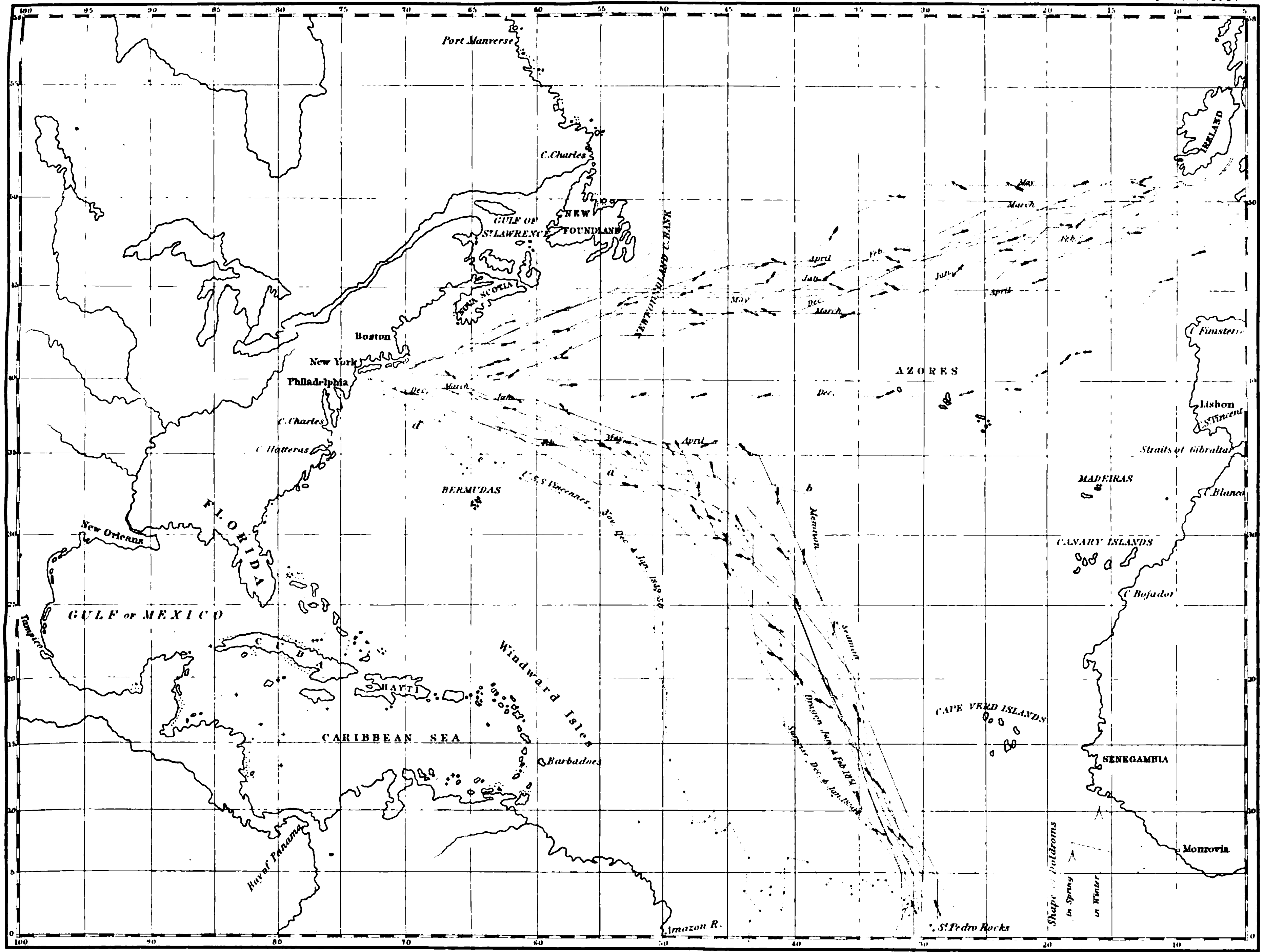
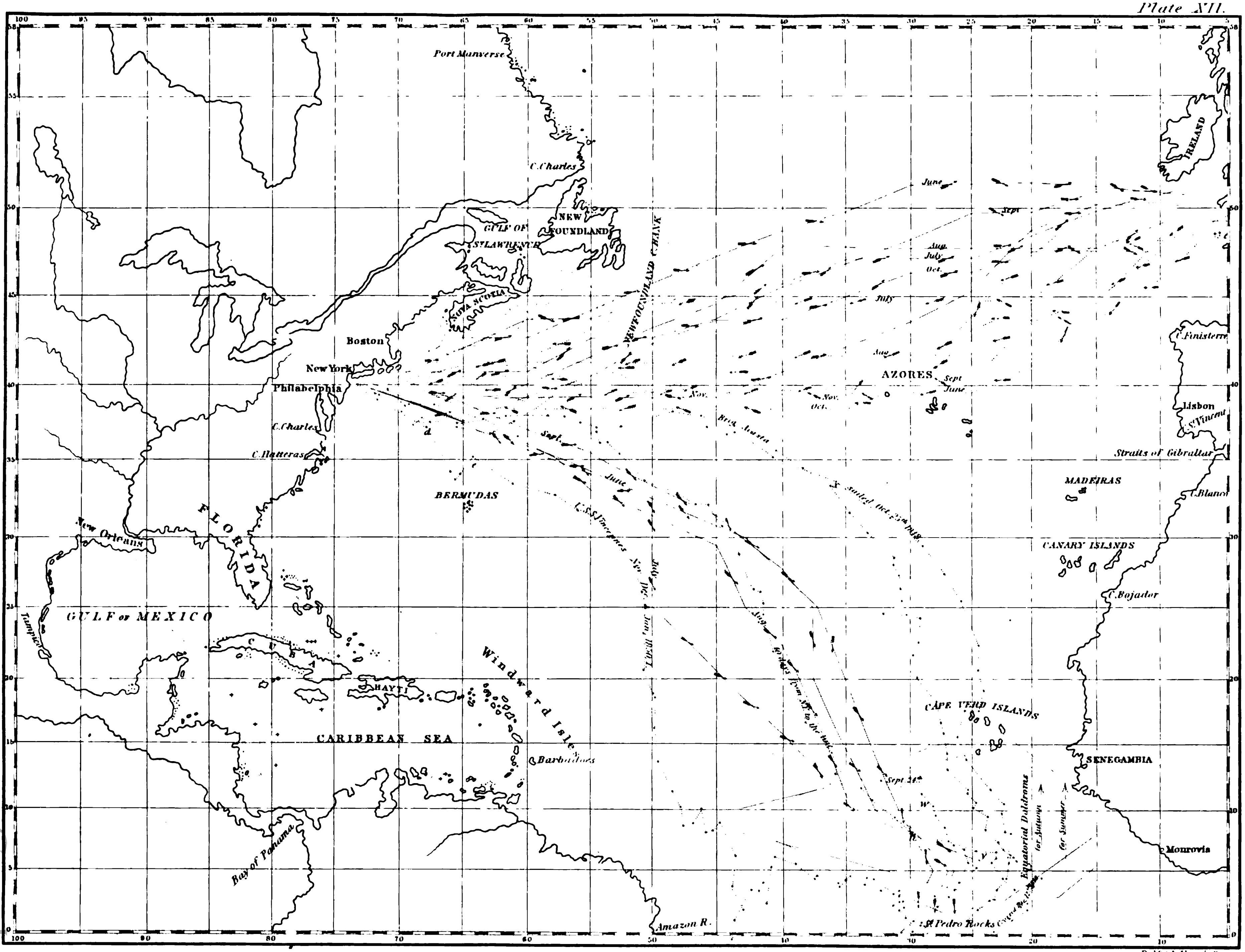
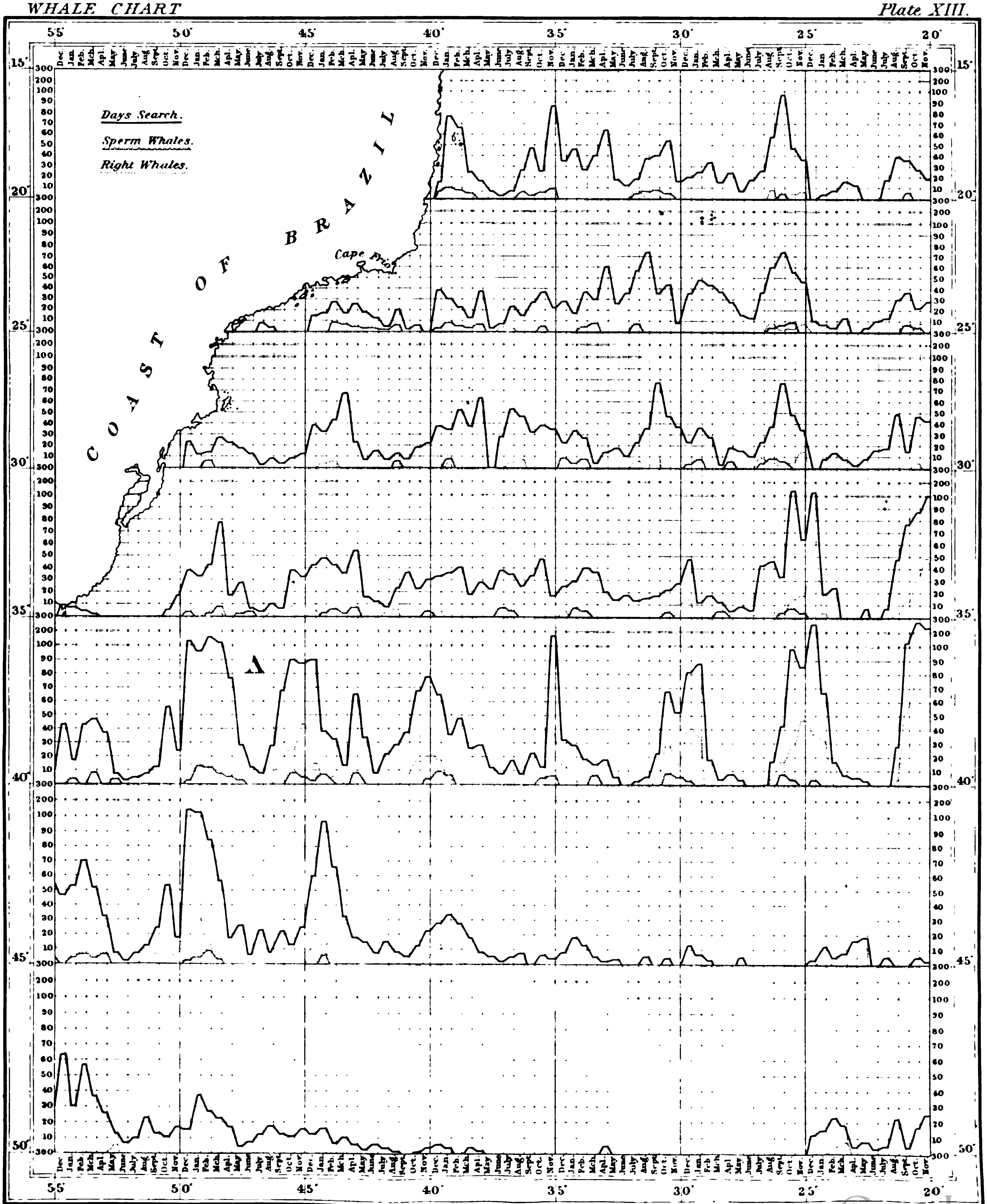

Port Manverse
C. Charles
GULF OF
St. LAWRENCE
NEW
FOUNDLAND
NEWFOUNDLAND BANK
NOVA SCOTIA
Boston
New York
Philadelphia
C. Charles
C. Hatteras
FLORIDA
New Orleans
GULF or MEXICO
Tampico
CUBA
HAYTI
CARIBBEAN SEA
Bay of Panama
Amazon R.
Barbadoes
Windward Isles
BERMUDAS
U.S.S. Vincennes, Nov. Dec. & Jan. 1849-50
Memnon
Seaman
Dragon Jan. & Feb. 1851
Surprise Dec. & Jan. 1850
St. Pedro Rocks
AZORES
IRELAND
C. Finisterre
Lisbon
C. St. Vincent
Straits of Gibraltar
MADEIRAS
C. Blanco
CANARY ISLANDS
C. Bojador
CAPE VERD ISLANDS
SENEGAMBIA
Monrovia
Shape of Doldrums
in Spring
in Winter
D. McClelland Sc.

Plate XII.



D. McClelland Sc.



D. M'Clelland Sc.

Vertical sections of the basin of the Atlantic and of the Amazon.

Plate XV.